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FOR ENQUIRING INTO  
THE HISTORY, THE ANTIQUITIES, THE ARTS AND  
SCIENCES, AND LITERATURE  
OF  
**A S I A.**

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## ERRATA.

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- Page 8, line 5 from the bottom dele "on."  
 11, 5 from ditto, for "or" read "in."  
 12, in the last dimension, for "Palatial" read "Palatine."  
 15, line 14, for "molars" read "molar."  
 21, 14, "19.2 inches" read "12.2 inches."  
 21, 17, "circle" read "arch."  
 22, 9, "form" read "forms."  
 29, 1, "decend lower" read "descend lower in."  
 31, 8, "He Sivalensis" read "H. Sivalensis."  
 31, 5, "2° to 30°" read "20° to 30°."  
 35, 7, "margin of foramen" read "margin of the posterior nasal foramen."  
 36, 15, "pyal" read "frontal"  
 40, 24, "uniform" read "reniform."  
 50, 25, "but" read "not."  
 53, 9, "upper" read "lower."  
 145, line 1, "Nufimenta" read "Rufimenta."  
 146, note, from "Erythrocephala" read "Erythroryncha."  
 146, line 6, for " $\frac{1}{18}$ " read " $\frac{1}{15}$ ."  
 157, for "Alaudino" read "Alaudinæ."  
 158, "Fringalanda" read "Fringalanda."  
 168, line 11, for "Corch" read "Concha."  
 169, 6 from bottom, for "Couch" read "Concha."  
 173, 4 from bottom, for "outer four" read "inner fore."  
 180, 6 from bottom, for "larea" read "nares."  
 184, lines 10—11, words former and latter transposed.  
 186, for "subgenus" read "genus."  
 190, line 5 from bottom, after above put *and*.  
 192, 2 from bottom, after well put *with*.





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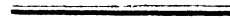
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I.

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SIVATHERIUM GIGANTEUM,  
A NEW FOSSIL RUMINANT GENUS

FROM THE VALLEY OF THE MARKANDA, IN THE SIVALLIK BRANCH  
OF THE SUB-HIMALAYAN MOUNTAINS.

---

BY HUGH FALCONER, M. D.

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AND

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*Superintendent, Doáb Canal.*

---

THE fossil which we are about to describe forms a new accession to extinct Zoology. This circumstance alone would give much interest to it. But in addition, the large size, surpassing the Rhinoceros; the family of Mammalia to which it belongs; and the forms of structure which it exhibits; render the *Sivatherium* one of the most remarkable of the past tenants of the globe, that have hitherto been detected in the more recent strata.

Of the numerous fossil mammiferous genera discovered and established by CUVIER, all were confined to the Pachydermata. The species belonging to other families, have all their living representatives on the earth. Among the Ruminantia, no remarkable deviation from existing types has hitherto been discovered, the fossil being closely allied to living species. The isolated position, however, of the Giraffe and the Camelidæ, made it probable, that certain genera have become extinct, which formed the

connecting links between those and the other genera of the family, and further between the Ruminantia and the Pachydermata. In the Sivatherium\* we have a ruminant of this description connecting the family with the Pachydermata, and at the same time so marked by individual peculiarities as to be without an analogue in its order.

The fossil remain of the Sivatherium, from which our description is taken, is a remarkably perfect head. When discovered, it was fortunately so completely enveloped by a mass of stone, that although it had long been exposed to be acted upon as a boulder in a water course, all the more important parts of structure had been preserved. The block might have been passed over, but for an edging of the teeth in relief from it, which gave promise of something additional concealed. After much labour, the hard crystalline covering of stone was so successfully removed, that the huge head now stands out with a couple of horns between the orbits, broken only near their tips, and the nasal bones projected in a free arch, high above the chaffron. All the molars on both sides of the jaw are present and singularly perfect. The only mutilation is at the vertex of the

---

\* We have named the fossil, *Sivatherium*, from SIVA, the Hindú god, and *θηριον bellua*. The *Siválik* or Sub-Himálayan range of hills, is considered in the Hindu mythology, as the *Lútiah* or edge of the roof of SIVA's dwelling in the *Himdlaya*, and hence they are called the *Siva-ala* or *Sib-ala*, which by an easy transition of sound became the *Sewálik* of the English. The fossil has been discovered in a tract which may be included in the *Sewálik* range, and we have given the name of *Sivatherium* to it, to commemorate this remarkable formation so rich in new animals. Another derivation of the name of the hills, as explained by the *Mahant* or High Priest at *Dehra*, is as follows :

*Sewálik*, a corruption of *Siva-wála*, a name given to the tract of mountains between the Jumna and Ganges, from having been the residence of Iswara SIVA and his son GANE's, who under the form of an Elephant had charge of the Westerly portion from the village of *Dúdhli* to the Jumna, which portion is also called *Gangaja*, *gaja* being in Hindí an Elephant. That portion Eastward from *Dúdhli* or between that village and *Haridwár* is called *Deodhar*, from its being the especial residence of *Deota* or Iswara SIVA : the whole tract however between the Jumna and Ganges is called *Siva-ala*, or the habitation of SIVA : unde der. *Sewálik*,

cranium where the plane of the occipital meets that of the brow : and at the muzzle which is truncated a little way in front of the first molar. The only parts which are still concealed, are a portion of the occipital, the zygomatic fossæ on both sides, and the base of the cranium over the sphenoid bone.

The form of the head is so singular and grotesque that the first glance at it strikes one with surprise. The prominent features are—1st, the great size approaching that of the Elephant : 2d, the immense developement and width of the cranium behind the orbits : 3d, the two divergent osseous cores for horns starting out from the brow between the orbits : 4th, the form and direction of the nasal bones, rising with great prominence out of the chaffron, and overhanging the external nostrils in a pointed arch : 5th, the great massiveness, width and shortness of the face forward from the orbits : 6th, the great angle at which the grinding plane of the molars deviates upwards from that of the base of the skull.

Viewed in lateral profile, the form and direction of the horns, and the rise and sweep in the bones of the nose, give a character to the head widely differing from that of any other animal. The nose looks something like that of the Rhinoceros : but the resemblance is deceptive, and only owing to the muzzle being truncated. Seen from in front, the head is somewhat wedge-shaped, the greatest width being at the vertex and thence gradually compressed towards the muzzle ; with contraction only at two points behind the orbits and under the malars. The zygomatic arches are almost concealed and nowise prominent : the brow is broad, and flat, and swelling laterally into two convexities ; the orbits are wide apart, and have the appearance of being thrown far forward, from the great production of the frontal upwards. There are no crests or ridges : the surface of the cranium is smooth, the lines are in curves, with no angularity. From the vertex to the root of the nose, the plane of the brow is in a straight line, with a slight rise between the horns. The accompanying drawings will at once give a better idea of the form than any description.

Now in detail of individual parts; and to commence with the most important and characteristic, the teeth:

There are six molars on either side of the upper jaw. The third of the series, or last milk molar, has given place to the corresponding permanent tooth, the detrition of which and of the last molar is well advanced and indicates the animal to have been more than adult.

The teeth are in every respect those of a ruminant with some slight individual peculiarities.

The three posterior or double molars are composed of two portions or semi-cylinders, each of which incloses, when partially worn down, a double crescent of enamel the convexity of which is turned inwards. The last molar, as is normal in ruminants, has no additional complication, like that in the corresponding tooth of the lower jaw. The plane of grinding slopes from the outer margin inwards. The general form is exactly that of an ox or camel, on a large scale. The ridges of enamel are unequally in relief, and the hollows between them unequally scooped. Each semi-cylinder has its outer surface, in horizontal section, formed of three salient knuckles, with two intermediate sinuses; and its inner surface, of a simple arch or curve. But there are certain peculiarities by which the teeth differ from those of other ruminants.

In correspondence with the shortness of jaw, the width of the teeth is much greater in proportion to the length than is usual in the family: the width of the third and fourth molars being to the length as 2.24 and 2.2 to 1.55 and 1.68 inches, respectively: and the average width of the whole series being to the length as 2.13 to 1.76 inches. Their form is less prismatic: the base of the shaft swelling out into a bulge or collar, from which the inner surface slopes outward as it rises: so that the coronal becomes somewhat contracted: in the third molar, the width at the coronal is 1.93, at the bulge of the shaft 2.24. The ridges and hollows on the outer surface descend less upon the shaft, and disappear upon the bulge. There are no accessory pillars on the furrow of junction at the inner side. The crescentic

plates of enamel have a character which distinguishes them from all known ruminants: the inner crescent, instead of sweeping in a nearly simple curve, runs zig-zag-wise in large sinuous flexures, somewhat resembling the form in the *Elasmotherium*.

The three double molars differ from each other only in their relative states of wearing. The antepenultimate, being most worn, has the crescentic plates less curved, more approximate and less distinct: the penultimate and last molars are less worn, and have the markings more distinct.

The three anterior or simple molars have the usual form, which holds in Ruminantia, a single semi-cylinder, with but one pair of crescents. The first one is much worn and partly mutilated: the second is more entire, having been a shorter time in use, and finely exhibits the flexuous curves in the sweep of the enamel of the inner crescent: the last one has the simple form of the permanent tooth which replaces the last milk molar: it also shews the wavy form of the enamel.

Regarding the position of the teeth in the jaw; the last four molars, viz. the three permanent and the last of replacement, run in a straight line, and on the opposite sides are parallel and equi-distant: the two anterior ones are suddenly directed inwards, so as to be a good deal approximated. If the two first molars were not thus inflected, the opposite lines of teeth would form exactly two sides of a square: the length of the line of teeth, and the intervals between the outer surfaces of the four last molars, being almost equal, viz. 9.8 and 9.9 inches respectively.

The plane of detrition of the whole series of molars from rear to front is not horizontal, but in a slight curve, and directed upwards at a considerable angle with the base of the skull: so that when the head is placed, so as to rest upon the occipital condyles and the last molars, a plane through these points is cut by a chord along the curve of detrition of the whole



series of molars at an angle of about 45°. This is one of the marked characters about the head :

<i>DIMENSIONS OF THE TEETH.</i>				<i>Length.</i>	<i>Breadth.</i>
				<i>Inches.</i>	<i>Inches.</i>
Last molar right side, .....				—	2.35
Penultimate do. ....				2.20	2.38
Antepenultimate do. ....				1.68	2.20
Last simple molar, .....				1.55	2.24
Second do. do. ....				1.70	1.95
First do. do. ....				1.70	1.90
				<i>Outer</i>	<i>Inner</i>
				<i>Surfaces.</i>	<i>Surfaces.</i>
Interval between the surfaces of last molar, .....				9.9	5.5
Do. do. do. third molar, .....				9.8	5.5
Do. do. do. second do. ....				8.4	4.5
Do. do. do. first do. ....				6.4	3.2

Space occupied by the line of molars 9.8 inches.

*Bones of the Head and Face.*—From the age of the animal to which the head had belonged, the bones had become ankylosed at their commissures, so that every trace of suture has disappeared, and their limits and connections are not distinguishable.

The frontal is broad and flat, and slightly concave at its upper half. It expands laterally into two considerable swellings at the vertex, and sweeps down to join the temporals in an ample curve; and with no angularity. It becomes narrower forwards, to behind the orbits; and then expands again in sending off an apophysis to join with the malar bone, and complete the posterior circuit of the orbit. The width of the bone where narrowest, behind the orbit, is very great, being 16.2 inches. Partly between and partly to the rear of the orbits, there arise by a broad base passing insensibly into the frontal two short thick conical processes. They taper rapidly to a point, a little way below which they are mutilated in

the fossil. They start so erect from the brow that their axis is perpendicular to their basement: and they diverge at a considerable angle. From their base upwards they are free from any rugosities, their surface being smooth and even. They are evidently the osseous cores of two intra-orbital horns. From their position and size they form one of the most remarkable features in the head. The connections of the frontal are nowhere distinguishable, no mark of a suture remaining. At the upper end of the bone the skull is fractured and the structure of the bone is exposed. The internal and outer plates are seen to be widely separated, and the interval to be occupied by large cells, formed by an expansion of the diploc into plates as in the Elephant. The interval exceeds  $2\frac{1}{2}$  inches in the occipital. On the left side of the frontal, the swelling at the vertex, has its upper lamina of bone removed, and the cast of the cells exhibits a surface of almond-shaped or oblong eminences with smooth hollows between.

The temporal is greatly concealed by a quantity of the stony matrix, which has not been removed from the temporal fossa. No trace of the squamous suture remains to mark its limits and connection with the frontal. The inferior processes of the bone about the auditory foramen have been destroyed or are concealed by stone. The zygomatic process is long and runs forward to join the corresponding apophysis of the jugal bone, with little prominence or convexity. A line produced along it would pass in front, through the tuberosities of the maxillaries, and to the rear along the upper margin of the occipital condyles. The process is stout and thick. The temporal fossa is very long and rather shallow. It does not rise up high on the side of the cranium; it is overarched by the cylinder-like sides of the frontal bone. The position and form of the articulating surface with the lower jaw are concealed by stone which has not been removed.

There is nothing in the fossil to enable us to determine the form and limits of the parietal bones: the cranium being chiefly mutilated in the region which they occupy. But they appear to have had the

same form and character as in the ox : to have been intimately united with the occipitals, and to have joined with the frontal at the upper angle of the skull.

The form and characters of the occipital are very marked. It occupies a large space, having width proportioned to that of the frontal, and considerable height. It is expanded laterally into two alæ, which commence at the upper margin of the foramen magnum and proceed upwards and outwards. These alæ are smooth, and are hollowed out downwards and outwards from near the condyles towards the mastoid region of the temporal. Their inner or axine margins proceed in a ridge arising from the border of the occipital foramen, diverging from each other nearly at right angles, and enclose a large triangular fossa into which they descend abruptly. This fossa, is chiefly occupied by stone in the fossil, but it does not appear shallow, and seems a modification of the same structure as in the Elephant. There is no appearance of an occipital crest or protuberance. The bone is mutilated at the sides towards the junction with the temporals. Both here and at its upper fractured margin its structure is seen to be formed of large cells with the diploe expanded into plates, and the outer and inner laminae wide apart. This character is very marked at its upper margin, where its cells appear to join on with those of the frontal. The condyles are very large and fortunately very perfect in the fossil, the longest diameter of each is 4.4 inches, and the distance measured, across the foramen magnum, from their outer angles, is 7.4 inches : dimensions exceeding those of the Elephant. Their form is exactly as in the Ruminantia, viz. their outer surface composed of two convexities meeting at a rounded angle : one in the line of the long axis stretching obliquely backwards from the anterior border of the foramen magnum ; on the other forwards and upwards from the posterior margin, their line of commissure being in the direction of the transverse diameter of the foramen. The latter is also of large size, its antero-posterior diameter being 2.3 inches, and the transverse diameter 2.6 inches. The large dimensions of the foramen

and condyles must entail a corresponding developement in the vertebræ, and modify the form of the neck and anterior extremities.

The sphenoidal bone, and all the parts along the base of the skull from the occipital foramen to the palate are either removed or so concealed by stone as to give no characters for description.

The part of the brow from which the nasal bones commence is not distinguishable. The suture connecting them with the frontal is completely obliterated : and it is not seen whether they run up into a sinus in that bone, or how they join on with it. Between the horns there is a rise in the brow, which sinks again a little forward. A short way in advance of a line connecting the anterior angles of the orbits, there is another rise in the brow. From this point, which may be considered their base, the nasal bones commence ascending from the plane of the brow, at a considerable angle. They are broad and well arched at their base, and proceed forward with a convex outline, getting rapidly narrower, to terminate in a point curved downwards, which overhangs the external nostrils. For a considerable part of their length they are joined to the maxillaries : but forwards from the point where they commence narrowing, their lower edge is free and separated from the maxillaries by a wide sinus : so that viewed in lateral profile their form very much resembles the upper mandible of a hawk, detached from the lower. Unluckily in the fossil, the anterior margins of the maxillaries are mutilated, so that the exact length of the nasal bone that was free from connection with them cannot be determined. As the fossil stands, about four inches of the lower edge of the nasals, measured along the curve, are free. The same mutilation prevents its being seen how near the incisives approached the nasals, with which they do not appear to have been joined. This point is one of great importance, from the structure it implies in the soft parts about the nose. The height and form of the nasal bones, are the most remarkable feature in the head : viewed from above they are seen to taper rapidly from

a broad base to a sharp point ; and the vertical height of their most convex part above the brow at their base, is  $3\frac{1}{2}$  inches.

The form of the maxillaries is strongly marked in two respects : 1st, their shortness compared with their great width and depth : 2d, in the upward direction of the line of alveoli from the last molar forwards, giving the appearance (with the licence of language intended to convey an idea of resemblance without implying more) as if the face had been pushed upwards to correspond with the rise in the nasals ; or fixed on at an angle with the base of the cranium. The tendency to shortness of the jaw was observed in the dimensions of the teeth, the molars being compressed, and their width exceeding their length to an extent not usual in the Ruminantia. The width apart, between the maxillaries, was noticed before ; the interval, between the outer surfaces of the alveoli, equalling the space in length occupied by the line of molars. The cheek tuberosities are very large and prominent, their diameter at the base being 2 inches and the width of the jaw over them being 12.2 inches, whereas at the alveoli it is but 9.8 inches. They are situated over the third and fourth molars ; and proceeding up from them towards the malar, there is an indistinct ridge on the bone. The infra-orbitary foramen is of large size, its vertical diameter being 1.2 inch ; it is placed over the first molar as in the ox and deer tribe. The muzzle portion of the bone is broken off at about 2.8 inches from the 1st molar, from the alveolar margin of which, to the surface of the diastema, there is an abrupt sink of 1.7 inch. The muzzle is here contracted to 5.8 inches, and forwards at the truncated part to about 4.1. The palatine arch is convex from rear to front, and concave across. No trace of the palatine foramina remains, nor of the suture with the proper palatine bones. The spheno-palatine apophyses and all back to the foramen magnum\* are

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\* With the exception of a portion of the basilar region, which resembles that of the Ruminants.

either removed or concealed in stone. In front, the mutilation of the bone, at the muzzle, does not allow it to be seen, how the incisive bones were connected with the maxillaries: but it appears that they did not reach so high on the maxillaries as the union of the latter with the nasals. The same cause has rendered obscure the connections of the maxillaries with the nasals, and the depth and size of the nasal echancrure or sinus.

The jugal bone is deep, massive and rather prominent. Its lower border falls off abruptly in a hollow descending on the maxillaries: the upper enters largely into the formation of the orbit. The posterior orbital process unites with a corresponding apophysis of the frontal to complete the circuit of the orbit behind. The zygomatic apophysis is stout and thick, and rather flat. No part of the arch, either in the temporal or jugal portions is prominent: the interval between the most salient points being greatly less than the hind part of the cranium, and slightly less than the width between the bodies of the jugals.

The extent and form of the lachrymals, cannot be made out, as there is no trace of a suture remaining. Upon the fossil, the surface of the lachrymary region passes smoothly into that of the adjoining bones. There is no perforation of the lower and anterior margin of the orbit by lachrymary foramina, nor any hollow below it indicating an infra-orbital or lachrymary sinus. It may be also added, what was omitted before, that there is no trace of a superciliary foramen upon the frontal.

The orbits are placed far forwards, in consequence of the great production of the cranium upwards, and the shortness of the bones of the face. Their position is also rather low, their centre being about 3.6 inches below the plane of the brow. From a little injury done in chisseling off the stone, the form or circle of the different orbits does not exactly correspond. In the one of the left side, which is the more perfect, the long axis makes a small angle with that of the plane of the brow: the antero-posterior diameter is 3.3 inches, and the vertical 2.7 inches. There is no prominence or inequality in the rim of the orbits, as in the Ruminantia. The plane

of the rim is very oblique: the interval between the upper or frontal margins of the two orbits being 12.2 inches, and that of the lower or molar margin 16.2 inches.

**\*DIMENSIONS OF THE SKULL OF THE *SIVATHERIUM GIGANTEUM*.**

	<i>Eng. Inches. Mètres.</i>	
From the anterior margin of the foramen magnum to the alveolus of 1st molar, ..	18.85	.478
From do. to the truncated extremity of the muzzle, .....	20.6	.5268
From do. to the posterior margin of the last molar, .....	10.3	.262
From the tip of the nasals to the upper fractured margin of the cranium, .....	18.0	.4568
From do. do. to do. along the curve, .....	19.0	.4822
From do. do. along the curve, to where the nasal arch begins to rise from the brow, .....	7.8	.198
From the latter point to the fractured margin of the cranium, .....	11.2	.284
From the tip of the nasals to a chord across the tips of the horns, .....	8.5	.216
From the anterior angle, right orbit, to the first molar, .....	9.9	.251
From the posterior do. do. to the fractured margin of the cranium, .....	12.1	.3075
Width of cranium at the vertex (mutilation at left side restored), about .....	22.0	.559
Do. between the orbits, upper borders, .....	12.2	.3095
Do. .... do. lower borders, .....	16.2	.4108
Do. behind the orbits at the contraction of the frontal, .....	14.6	.3705
Do. between the middle of the zygomatic arches, .....	16.1	.4168
Do. between the bodies of the malar bones, .....	10.62	.2722
Do. base of the skull behind the mastoid processes (mutilated on both sides,) ..	19.5	.496
Do. between the cheek tuberosities of the maxillaries, .....	12.2	.3095
Do. of muzzle portion of the maxillaries in front of the first molar, .....	5.8	.149
Do. of do. where truncated (partly restored,) .....	4.1	.104
Do. between the outer surfaces of the horns at their base, .....	12.5	.312
Do. .. do. .... do. fractured tips of ditto, ....	13.05	.317
Perpendicular from a chord across tips of do. to the brow, .....	4.2	.165
Depth from the convexity of the occipital condyles to middle of frontal behind the horns, .....	11.9	.302
Do. from the body of the sphenoidal to do. between the horns, .....	9.94	.252
Do. from middle of the palate between the 3d and 4th molars do. at root of the nasals, .....	7.52	.192
Do. from posterior surface last molar to extremity of the nasals, .....	13.0	.331
Do. from grinding surface penultimate molar to root of the nasals, .....	10.3	.262
Do. from the convexity near the tip of the nasals to the palatal surface in front of the first molar, .....	5.53	.14

\* To facilitate comparison with the large animals described in CUVIER's *Ossements Fossiles*, the dimensions are also given in French measure.

	<i>Eng. Inches.</i>	<i>Mètres.</i>
Depth from middle of the ala of the occipital to the swell at vertex of frontal, ..	8.98	.228
Do. from inferior margin of the orbit to grinding surface 5th molar, .....	7.3	.186
Do. from the grinding surface 1st molar to edge of the palate in front of it, ....	2.6	.066
Space from the anterior angle of orbit to tip of the nasals, .....	10.2	.2595
Antero-posterior diameter left orbit,.....	3.3	.084
Vertical do. do. ....	2.7	.0685
Antero-posterior diameter of the foramen magnum, .....	2.3	.058
Transverse do. do. ....	2.6	.066
Long diameter of each condyle, .....	4.4	.112
Short or transverse do. of do. ....	2.1	.0603
Interval between the external angles of do. measured across the foramen, .....	7.4	.188

Among a quantity of bones collected in the neighbourhood of the spot in which the skull was found, there is a fragment of the lower jaw of a very large ruminant which we have no doubt belonged to the *Sivatherium*: and it is even not improbable that it came from the same individual with the head described. It consists of the hind portion of the right jaw broken off at the anterior third of the last molar. The coronoid apophysis, the condyle, with the corresponding part of the ramus, and a portion of the angle are also removed. The two posterior thirds only, of the last molar, remain; the grinding surface partly mutilated, but sufficiently distinct to show the crescentic plates of enamel, and prove that the tooth belonged to a ruminant. The outline of the jaw in vertical section, is a compressed ellipse, and the outer surface more convex than the inner. The bone thins off, on the inner side towards the angle of the jaw, into a large and well marked muscular hollow: and running up from the latter, upon the ramus towards the foramen of the artery there is a well defined furrow, as in the *Ruminantia*. The surface of the tooth is covered with very small rugosities, and striæ, as in the upper molars of the head. It had been composed of three semi-cylinders, as is normal in the family, and the advanced state of its wearing proves the animal from which it proceeded to have been more than adult.



The form and relative proportions of the jaw agree very closely with those of the corresponding parts of a buffalo. The dimensions compared with those of the buffalo and camel are thus :

	<i>Sivatherium.</i>	<i>Buffalo.</i>	<i>Camel.</i>
Depth of the jaw from the alveolus last molar, .....	4.95 inch.	2.65 inch.	2.70 inch.
Greatest thickness of do. ....	2.3	1.05	1.4
Width of middle of last molar, .....	1.35	0.64	0.76
Length of posterior 2-3d of do. ....	2.15	0.95	1.15

No known ruminant, fossil or existing, has a jaw of such large size ; the average dimensions above given being more than double those of a Buffalo, which measured in length of head 19.2 inches (.489 mètres); and exceeding those of the corresponding parts of the Rhinoceros. We have therefore no hesitation in referring the fragment to the *Sivatherium Giganteum*.

The above comprises all that we know regarding the osteology of the head from an actual examination of the parts. We have not been so fortunate hitherto, as to meet with any other remain, comprising the anterior part of the muzzle either of the upper or lower jaw.\* We shall now proceed to deduce the form of the deficient parts, and the structure of the head generally, to the extent that may be legitimately inferred, from the data of which we are in possession.

Notwithstanding the singularly perfect condition of the head, for an organic remain of such enormous size, we cannot but regret the mutilation

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\* In a note received from Captain CAUTLEY while this paper is in the press, that gentleman mentions the discovery of a portion of the skeleton of a *Sivatherium* in another part of the hills : See *Journal As. Soc. Vol. IV.* " During my recent trip to the *Sivdliks* near the Pinjôr valley, the field of Messrs. BAKER and DURAND's labours, I regretted much my inability to obtain the dimensions of one of the most superb fossils I suppose that ever was found. It was unfortunately discovered and excavated by a party of work people employed by a gentleman with whom I was unacquainted, and although I saw the fossil when in the rock, I was prevented from getting the measurements afterwards. This specimen consisted of the femur and tibia, with the tarsal, metatarsal, and phalanges of our *Sivatherium*." It is much to be regretted that such an opportunity should have been lost of adding to the information already acquired of this new and gigantic Ruminant.—SEC.

at the muzzle and vertex, as it throws a doubt upon some very interesting points of structure in the *Sivatherium*: 1st, the presence or absence of incisive and canine teeth in the upper jaw, and their number and character if present; 2d, the number and extent of the bones which enter into the basis of the external nostrils; and 3d, the presence or absence of two horns on the vertex, besides the two intra-orbital ones.

Regarding the first point, we have nothing sufficient to guide us with certainty to a conclusion, as there are ruminants both with and without incisives and canines in the upper jaw; and the *Sivatherium* differs most materially in structure from both sections. But there are two conditions of analogy which render it probable that there were no incisives. In all ruminants which have the molars in a contiguous and normal series, and which have horns on the brow, there are no incisive teeth. In the Camel and its congeners, where the anterior molar is unsymmetrical and separated from the rest of the series by an interval, incisives are present in the upper jaw. The *Sivatherium* had horns, and its molars were in a contiguous series: it is therefore probable that it had no incisives. Regarding the canines there is no clue to a conjecture, as there are species in the same genus of ruminants both with and without them. 2. The extent and connections of the incisive bones are points of great interest, from the kind of developement which they imply in the soft parts appended to them.

In most of the horned ruminantia, the incisives run up by a narrow apophysis along the anterior margins of the maxillary bones, and join on to a portion of the sides of the nasals; so that the bony basis of the external nostrils is formed of but two pairs of bones, the nasals and the incisives. In the Camel, the apophyses of the incisives terminate upon the maxillaries without reaching the nasals, and there are three pairs of bones to the external nostrils, the nasals, maxillaries and incisives. But neither in the horned ruminants, nor in the Camel and its congeners, do the bones of the nose rise out of the plane of the brow with any remarkable degree of saliency, nor are their lower margins free to any great extent towards the

apex. They are long slips of bone, with nearly parallel edges, running between the upper borders of the maxillaries, and joined to the ascending process of the incisive bone, near their extremity, or connected only with the maxillaries ; but in neither case projecting so as to form any considerable re-entering angle, or sinus, with these bones.

In our fossil, the form and connections of the nasal bones, are very different. Instead of running forward in the same plane with the brow, they rise from it at a rounded angle of about  $130^{\circ}$ , an amount of saliency without example among ruminants, and exceeding what holds in the Rhinoceros, Tapir, and Palæotherium, the only herbivorous animals with this sort of structure. Instead of being in nearly parallel slips, they are broad, and well arched at their base, and converge rapidly to a sharp tip which is hooked downwards over-arching the external nostrils. Along a considerable portion of their length they are unconnected with the adjoining bones, their lower margins being free and so wide apart from the maxillaries, as to leave a gap or sinus of considerable length and depth in the bony parietes of the nostrils. The exact extent to which they are free, is unfortunately not shown in the fossil, as the anterior margin of the maxillaries is mutilated on both sides, and the connection with the incisives destroyed. But as the nasal bones shoot forward beyond the mutilated edge of the maxillaries, this circumstance, together with their well defined outline and symmetry on both sides of the fossil, and their rapid convergence to a point with some convexity, leaves not a doubt that they were free to a great extent and unconnected with the incisives.

Now to determine the conditions in the fleshy parts, which the structure in the bony parietes of the nostrils entails.

The analogies are to be sought for in the ruminantia and pachydermata.

The remarkable saliency of the bones of the nose in the Sivatherium, has no parallel, in known ruminants, to guide us ; and the connection of the nasals with the incisives, or the reverse, does not imply any important difference in structure in the family. In the Bovine section, the Ox and

the Buffalo have the nasals and incisives connected: whereas they are separate in the Yak\* and Aurochs. In the Camel, they are also separate, and this animal has greater mobility in the upper lip than is found in other ruminants.

In the Pachydermata, both these conditions of structure are present and wanting, in different genera; and their presence or absence is accompanied with very important differences in the form of the corresponding soft parts. It is therefore in this family that we are to look for an explanation of what is found in the Sivatherium.

In the Elephant and Mastodon, the Tapir, Rhinoceros and Palæotherium there are three pairs of bones to the external nostrils; the nasals, the maxillaries and incisives.† In all these animals, the upper lip is highly developed, so as to be prehensile as in the Rhinoceros, or extended into a trunk as in the Elephant and Tapir; the amount of developement being accompanied with corresponding difference in the position and form of the nasal bones. In the Rhinoceros they are long and thick, extending to the point of the muzzle, and of great strength to support the horns of the animal: and the upper lip is broad, thick and very mobile, but little elongated. In the Elephant they are very short, and the incisives enormously developed for the insertion of the tusks, and the trunk is of great length. In the Tapir they are short and free except at the base, and projected high above the maxillaries; and the structure is accompanied by a well developed trunk. In the other pachydermatous genera, there are but two pairs of bones to the external nostrils, the nasals and the incisives: the latter running up so as to join on with the former; and the nasals, instead of being short and salient, with a sinus laterally between them and the maxillaries, are long and run forward united to the maxillaries, more or less resembling the nearly parallel slips of the Ruminantia. Of this genera

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\* CUVIER. Ossemens Fossiles, tome iv. p. 131.

† CUVIER. Ossemens Fossiles, tome iii. p. 29.

the horse has the upper lip endowed with considerable mobility ; and the lower end of the nasals is at the same time free to a small extent. In all the other genera, there is nothing resembling a prehensile organ in the upper lip.

In the Sivatherium, the same kind of structure holds, as is found in the Pachydermata with trunks. Of these it most nearly resembles the Tapir. It differs chiefly in the bones of the nose being larger and more salient from the Chaffron ; and in there being less width and depth to the nasomaxillary sinus, than the Tapir exhibits. But as the essential points of structure are alike in both, there is no doubt that the Sivatherium was invested with a trunk like the Tapir.

This conclusion is further borne out by other analogies although more indirect than that afforded by the nasal bones.

1st.—The large size of the infra-orbitary foramen. In the fossil the exact dimensions are indistinct, from the margin having been injured in the chisseling off of the matrix of stone : the vertical diameter we make out to be 1.2 inch, which perhaps may be somewhat greater than the truth : but any thing approaching this size, would indicate a large nerve for transmission and a highly developed condition of the upper lip.

2d.—The external plate of the bones of the cranium is widely separated from the inner, by an expansion of the diploe into vertical plates, forming large cells, as in the cranium of the Elephant : and the occipital is expanded laterally into alæ, with a considerable hollow between, as in the Elephant. Both these conditions are modifications of structure, adapted for supplying an extensive surface for muscular attachment, and imply a thick fleshy neck, with limited range of motion ; and, in more remote sequence, go to prove the necessity of a trunk.

3d.—The very large size of the occipital condyles, which are greater both in proportion and in actual measurement than those of the Elephant, the interval between their outer angles, taken across the occipital foramen, being 7.4 inches. The atlas, and the rest of the series of cervical vertebræ,

must have been of proportionate diameter to receive and sustain the condyles, and surrounded by a large mass of flesh. Both these circumstances would tend greatly to limit the range of motion of the head and neck. But to suit the herbivorous habits of the animal, it must have had some other mode of reaching its food ; or the vertebræ must have been elongated in a ratio to their diameter sufficient to admit of free motion to the neck. In the latter case the neck must have been of great length, and to support it and the load of muscles about it, an immense developement would be required in the spinal apophysis of the dorsal vertebræ, and in the whole anterior extremity, with an unwieldy form of the body generally. It is therefore more probable that the vertebræ were condensed as in the Elephant, and the neck short and thick, admitting of limited motion to the head : circumstances indirectly corroborating the existence of a trunk.

4th.—The face is short, broad and massive, to an extent not found in the Ruminantia, and somewhat resembling that of the Elephant, and suitable for the attachment of a trunk.

Next with regard to the horns :—

There can be no doubt, that the two thick short and conical processes between the orbits, were the cores of horns, resembling those of the Bovine and Antilopine sections of the Ruminantia. They are smooth, and run evenly into the brow without any burr. The horny sheaths which they bore, must have been straight, thick, and not much elongated. None of the bicorned Ruminantia have horns placed in the same way, exactly between and over the orbits : they have them more or less to the rear. The only ruminant which has horns similar in position is the four-horned Antelope\* of Hindustán, which differs only in having its anterior pair of horns a little more in advance of the orbits, than occurs in the Sivatherium. The correspondence of the

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\* The *Tetracerus* or *Antelope Quadricornis* and *Chekura* of authors.

two at once suggests the question, "had the Sivatherium also two additional horns on the vertex?" The cranium in the fossil is mutilated across at the vertex, so as to deprive us of direct evidence on the point, but the following reasons render the supposition at least probable:

1st.—As above stated, in the bi-cavicorned Ruminantia the osseous cores are placed more or less to the rear of the orbits.

2d.—In such known species as have four horns, the supplementary pair is between the orbits, and the normal pair well back upon the frontal.

3d.—In the Bovine section of Ruminantia, the frontal is contracted behind the orbits, and upwards from the contraction it is expanded again into two swellings at the lateral angles of the vertex which run into the bases of the osseous cores of the horns. This conformation does not exist in such of the Ruminantia as want horns or as have them approximated on the brow. It is present in the Sivatherium.

On either supposition, the intra-orbitary horns are a remarkable feature in the fossil: and if they were a solitary pair on the head, the structure, from their position, would perhaps be more singular, than if there had been two additional horns behind.

Now to estimate the length of the deficient portion of the muzzle, and the entire length of the head:—

In most of the Ruminantia where the molars are in a contiguous uninterrupted series, the interval from the first molar to the anterior border of the incisive bones is nearly equal to the space occupied by the molars; in some greater, in some a little less, and generally the latter. In other Ruminantia such as the Camelidæ, where the anterior molars are insymmetrical with the others, and separated from them by being placed in the middle of the diasteme this ratio does not hold; the space from the first molar to the margin of the incisives being less than the line of molars. In the Sivatherium the molars are in a contiguous series, and if on this analogy we deduce the length of the muzzle, we get nearly 10 inches for the space from the first

molar to the point of the incisives ; and 28.85 inches for the whole length of the head, from the border of the occipital foramen to the margin of the incisives ; these dimensions may be a little excessive, but we believe them not to be far out, as the muzzle would still be short for the width of the face, in a ruminant.

The orbits next come to be considered. The size and position of the eye form a distinguishing feature between the Ruminantia and the Pachydermata. In the former it is large and full, in the latter smaller and sunken ; and the expression of the face is more heavy in consequence. In the *Sivatherium* the orbit is considerably smaller in proportion to the size of the head than in existing ruminants. It is also placed more forward in the face, and lower under the level of the brow. The rim is not raised and prominent as in the Ruminantia, and the plane of it is oblique ; the interval between the orbits at their upper margin being 19.2 inches, and at the lower 16.2 inches. The longitudinal diameter exceeds the vertical in the ratio of 5 to 4 nearly, the long axis being nearly in a line from the naso-maxillary sinus across the hind limb of the zygomatic circle. From the above we infer that the eye was smaller and less prominent than in existing ruminants : and that the expression of the face was heavier and more ignoble, although less so than in the Pachydermata, excepting the horse ; also that the direction of vision was considerably forwards as well as lateral, and that it was cut off, towards the rear.

This closes what we have been led to infer regarding the organs of the head. With respect to the rest of the skeleton, we have nothing to offer, as we are not at present possessed of any other remains which we can with certainty refer to the *Sivatherium*.\* Among a quantity of bones† collected from the same neighbourhood with the head fossil, there are three singularly

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\* See Note to page 17. SEC.

† We note here a very perfect cervical vertebra of a Ruminant in our possession, which must have belonged to an animal of proportions equal to that of the *Sivatherium*, but from certain



perfect specimens of the lower portions of the extremities of a large ruminant, belonging to three legs of one individual. They greatly exceed the size of any known ruminant, and excepting the *Sivatherium Giganteum*, there is no other ascertained animal of the order, in our collection, of proportionate size to them. We forbear from further noticing them at present, as they appear small in comparison for our fossil : and besides, there are indications in our collection, in teeth and other remains, of other large ruminants, different from the one we have described.

The form of the vertebræ and more especially of the carpi and tarsi, are points of great interest, to be ascertained ; as we may expect modifications of the usual type adapted to the large size of the animal. From its bulk and armed head, few animals could be strong enough to contend with it, and we may expect that its extremities were constructed more to give support, than for rapidity of motion. But, in the rich harvest which we still hope to reap in the valleys of the *Markanda*, it is probable that specimens to illustrate the greater part of the osteology of the *Sivatherium* will at no very distant period be found.

The structure of the teeth suggests an idea regarding the peculiarities of the herbivorous habits of the animal. In the description it was noticed that the inner central plate of enamel ran in a flexuous sweep, somewhat resembling what is seen in the *Elasmotherium*, an arrangement evidently intended to increase the grinding power of the teeth. It may hence be inferred, that the food of the *Sivatherium* was less herbaceous than that of existing horned ruminants, and derived from leaves and twigs : or that as in the horse, the food was more completely masticated, the digestive organs less complicated, the body less bulky, and the necessity of regurgitation from the stomach less marked than in the present Ruminantia.

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characters, we are inclined to suspect that it is allied to some other gigantic species of Ruminant, of the existence of which we have already a tolerable certainty. Of the existence of the Elk, and a species of *Camelidæ*, Lieut. BAKER of the Engineers has shewn us ample proof.

The following dimensions contrasted with those of the Elephant and Rhinoceros, will afford a tolerably accurate idea of the size of the Sivatherium. They are characteristic although not numerous :—

	<i>Elephant.</i>	<i>Sivatherium.</i>	<i>Indian 1-horned Rhinoceros.</i>
From margin of foramen magnum to the first molar, ..	23.10 inch.	18.85 inch.	24.9 inch.
Greatest width of the cranium, .....	26.0	22.0	12.05
Do. do. of face between the malar bones, .....	18.5	16.62	9.20
Greatest depth of the skull, .....	17.80	11.9	11.05
Long diameter of the foramen magnum, .....	2.55	2.6	2.6
Short do. do. do. ....	2.4	2.3	1.5
Average of the above, .....	15.03	12.38	10.22

If the view which we have taken of the fossil be correct, the Sivatherium was a very remarkable animal, and it fills up an important blank in the interval between the Ruminantia and Pachydermata. That it was a ruminant, the teeth and horns most clearly establish ; and the structure which we have inferred of the upper lip, the osteology of the face, and the size and position of the orbit, approximate it to the Pachydermata. The circumstance of any thing approaching a proboscis is so abnormal for a ruminant, that at the first view, it might raise a doubt, regarding the correctness of the ordinal position assigned to the fossil : but when we inquire further, the difficulty ceases.

In the Pachydermata, there are genera with a trunk, and others without a trace of it. This organ is therefore not essential to the constitution of the order, but accidental to the size of the head, or habits of the animal in certain genera. Thus in the Elephant, nature has given a short neck to support the huge head, the enormous tusks and the large grinding apparatus of the animal ; and by such an arrangement, the construction of the rest of the frame is saved from the disturbance which a long neck would have entailed. But as the lever of the head became shortened, some other method of reaching its food became necessary ; and a trunk was appended to

the mouth. We have only to apply analogous conditions to a ruminant, and a trunk is equally required. In fact, the Camel exhibits a rudimentary form of this organ, under different circumstances. The upper lip is cleft ; each of the divisions is separately moveable and extensible, so as to be an excellent organ of touch.

The fossil was discovered near the *Markanda* river, in one of the small valleys which stretch between the *Kyárda-dún* and the valley of *Pin-jór* in the *Siválik* or Sub-himalayan belt of hills, associated with bones of the fossil Elephant, Mastodon, Rhinoceros, Hippopotamus, &c. So far as our researches yet go, the Sivatherium was not numerous. Compared with the Mastodon and Hippopotamus, (*H. Siválensis*, Nobis, a new species characterized by having six incisors in either jaw) it was very rare.

*Northern Doáb, September 15, 1835.*

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II.

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NOTE

ON THE

FOSSIL CROCODILE,

OF THE

SIVĀLIK HILLS.

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BY CAPTAIN P. T. CAUTLEY,  
*Superintendent, Doáb Canal.*

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OF the skulls of the existing Crocodile from which the measurements accompanying this note have been taken, one belongs to an animal 7 feet long of which we have the perfect skeleton ; and the other was stated by the person from whom it was procured, to have belonged to an animal of 12 feet : we have a correction however in the smaller specimen, which was carefully measured ; and taking this as a type, the animals being of the same species (*C. Biporcatus*, Cuvier), a mean of four measurements gives us a length of 132.09 inches, or 11 feet .09 inches, for the latter. In fixing this specimen as belonging to an animal of 11 feet, we shall not therefore be far from the truth.

There is so much difference in the few comparative measurements that we have been able to obtain of the fossil, with these two skulls, that it is hardly possible to take any proportion of the existing animal as a guide to that of the fossil : the measurements taken separately would in some cases reduce our fossil to that of an animal of 11 feet, with distinct ocular proof to the contrary ; in others the fossil animal would be 17 feet long, which

may probably be somewhere near the actual size : while an assumption of 20 feet would be extending the dimensions to their utmost limit, our estimate being guided by the proportions of the species now existing in our rivers.

The fossils from which the measurements were taken, consist of two very perfect fragments ; first, the anterior portion of the skull of a large and adult animal, the posterior part from the palatal sinus being wanting ; in this the front of the lower jaw consisting of the left dental from the 1st to the 8th tooth, and of the right from the 1st to the 4th is fixed—the fragments of the upper and lower jaw being united : a point proving that some at least of these remains were inhumed before the disintegration of the muscles and integument connecting them ; and secondly, the posterior part of the skull, from the occipital to the front of the orbits, of an adult but of a smaller animal than the preceding.

The 4th tooth in each side of the lower jaw being received into a groove into the upper—the form and size of the cranial foramina, together with those of the protuberances and indentations of the muzzle, place our fossil amongst the true Crocodiles, the species being *allied* to CUVIER'S *Biporcatus*, or the Crocodile, “*a deux arrêtes*” now existing in these rivers.

The following measurements will facilitate the reference to CUVIER'S *Ossements fossiles* ; and be perhaps of still further use in providing the means for general reference on points relating to the existing Crocodile.

<p><i>Dimensions of Skull—upper jaw— number of teeth 38.</i></p>	<p><i>Existing Crocodile.</i></p>				<p><i>Fossil.</i></p>	
	<p><i>11 Feet long.</i></p>		<p><i>7 Feet long.</i></p>			
		<i>Inches.</i>	<i>Metres.</i>	<i>Inches.</i>	<i>Metres.</i>	<i>Inches.</i>
Length from point of muzzle to posterior extremity or margin of occipital condyle,.....	17.1	0.435	11.3	0.286	—	—
Breadth on the temporal bones at the articulation with lower jaw, .....	11.2	0.284	6.7	0.170	—	—
Ditto between the most prominent points of the alveoli of the 15th tooth,.....	8.1	0.260	5.0	0.126	—	—
Ditto between ditto ditto 10th ditto, .....	6.7	0.170	4.2	0.107	9.2	0.234
Ditto between ditto ditto 4th ditto, .....	4.7	0.119	2.7	0.069	6.0	0.152
Length of intermaxillaries on suture below,....	3.2	0.0805	2.45	0.062	4.3	0.109
Ditto of maxillaries ditto,.....	3.9	0.099	2.4	0.060	3.8	0.096

<i>Dimensions of Cranium—upper jaw—</i>	<i>Existing Crocodile.</i>				<i>Fossil.</i>	
	<i>11 Feet long.</i>		<i>7 Feet long.</i>			
	<i>Inches.</i>	<i>Metres.</i>	<i>Inches.</i>	<i>Metres.</i>	<i>Inches.</i>	<i>Metres.</i>
Length of palatine bones on suture below,.....	5.65	0.142	3.7	0.093		
Ditto of sphenoid ditto,.....	3.4	0.086	1.75	0.044		
Extreme breadth across the pterygoid apophyses of sphenoid, .....	7.2	0.182	4.4	0.112		
Length from point of muzzle to anterior of orbit	11.5	0.290	7.3	0.186		
Ditto ditto to ditto of lachrymal bone,	8.4	0.211	5.5	0.140		
Breadth of the frontal bone on its junction with lachrymal, .....	1.9	0.048	1.1	0.027		
Ditto on the posterior frontals at their junction with the mastoid bones, .....	4.55	0.115	3.0	0.076		
Length of external nostril or nasal aperture, ..	2.05	0.052	1.40	0.035	3.1	0.079
Breadth of ditto ditto, .....	1.7	0.043	0.95	0.024	2.8	0.070
Length of crotaphite foramina or those bounded by the poster. frontal, mastoid and parietal bones, .....	1.3	0.032	0.90	0.022		
Breadth of ditto ditto ditto ditto .....	0.9	0.022	0.70	0.017		
Breadth of occipital condyle, .....	1.3	0.032	0.90	0.022		
Ditto of occipital foramen, .....	0.9	0.022	0.70	0.017		
Depth of ditto,.....	0.65	0.016	0.45	0.012		
Diameter of 4th tooth upper jaw at its alveolus,	0.5	0.126	0.30	0.008	1.0	0.026
Ditto 10th ditto ditto,.....	0.85	0.021	0.42	0.108	1.15	0.029
Length from point of muzzle to maxillary extremity of palatine bone,.....	7.05	0.180	4.8	0.122	7.9	0.20
Breadth of intermaxillaries on suture ; i. e. between nasal aperture and point of muzzle,....	1.7	0.043	1.1	0.027	3.6	0.190
Width between grooves on upper jaw for receiving the 4th lower teeth, .....	3.95	0.10	2.35	0.060	5.35	0.136
<i>Lower jaw—number of teeth 30.</i>						
Length from muzzle to posterior extremity of articular bone, .....	21.5	0.548	14.2	0.36		
Extreme breadth at the articular bone,.....	10.0	0.254	6.3	0.16		
Breadth at the oval aperture formed by the junction of the three bones, .....	11.7	0.296	7.1	0.18		
Greatest depth of jaw, .....	3.5	0.088	2.3	0.058		
Length of symphysis, .....	2.95	0.074	1.8	0.046	2.9	0.073
Depth of jaw between 8th and 9th tooth,.....	1.55	0.039	0.9	0.022		
Length of oval aperture at the posterior extremity of dental bone,.....	1.85	0.048	1.1	0.027		
Depth of ditto ditto, .....	1.10	0.027	0.5	0.126		
Distance between posterior extremity of oval aperture and posterior extremity of articular bone, .....	6.55	0.167	4.0	0.102		

From the sutures being obliterated on the upper rugged surface of the fossil, the junction of the lachrymal and anterior frontal on the maxillary

bone is not observable, and as this is one of the points upon which the Cayman and Crocodile differ, it is perhaps to be regretted that this must remain at present doubtful; for although the characters above given distinguish the fossil from the Cayman, the bluntness of the muzzle and the proportions of the bones of the head do, in some respects, assimilate it with the latter sub-genus.

On the lower smooth surface the sutures are well defined, and it is on this measurement that we observe the remarkable distinction between the existing and the fossil animal: the shortness of the maxillary bones and the length of the intermaxillaries, including the nasal aperture, is a peculiarity that will be observed in the table of measurements, the former (maxillary) in the existing animal being to the latter (intermaxillary) as 3.9 is to 3.2. In the fossil as 3.8 is to 4.3. The length of the maxillary bones on the lower suture, or the space separating the palatine from the intermaxillaries, being rather greater in the existing animal of 11 feet than in the fossil. The comparative measurement from the point of the muzzle to the maxillary extremity of the palatine bone, together with those across the skull at the 10th and 4th teeth, will point out in a still clearer way the bluntness and breadth of the muzzle of the fossil animal. By the extension of the intermaxillaries and the great length of the connecting suture between the point of the muzzle and the nasal aperture, this aperture is thrown further back, so that a line drawn transversely through the grooves for receiving the 4th lower teeth, (which in the existing animal would cut the *posterior* extremity,) in the fossil, passes through the *centre* or rather in *front* of the centre of the nasal aperture.

The skulls of the true Crocodile and Cayman differ in the following points. 1. That of the Cayman is less oblong, shorter, and flatter at the muzzle. 2. The 4th tooth of the lower jaw enters into a hole in the upper, instead of a groove as in the true Crocodile. 3. They differ in the number of teeth. 4. The cranial foramina bounded by the posterior, frontal, mastoid and parietal bones, are smaller, and sometimes altogether wanting in

the Cayman. 5. The lachrymal and anterior frontal bones descend lower the Crocodiles than in the Caymans. 6. In the Cayman a part of the vomer is visible in the palate between the maxillaries and intermaxillaries. 7. The palatine bones advance more in the palate and are wider in front in the same animal. 8. The posterior nostrils are wider than they are long.

With regard to the cranial foramina of the fossil, and their proportion relatively to the surrounding bones, we are enabled, by having in our possession a very perfect fragment of the occipital region and that portion of the skull bounded by the orbits, to give the comparative measurements here also; noting that this fossil is a portion of the skull of an animal of much smaller dimensions than that from which the former measurements were taken.

	<i>Existing Crocodile.</i>				<i>Fossil Crocodile.</i>	
	<i>11 Feet long.</i>		<i>7 Feet long.</i>			
	<i>Inches.</i>	<i>Mètres.</i>	<i>Inches.</i>	<i>Mètres.</i>	<i>Inches.</i>	<i>Mètres.</i>
Length of crotaphite foramina, .....	1.30	0.032	0.9	0.022	1.40	0.036
Breadth of ditto, .....	0.90	0.022	0.70	0.017	1.0	0.026
Breadth of the frontal bone on its junction with lachrymal, .....	1.9	0.048	1.1	0.027	2.1	0.053
Ditto on posterior frontals at their junction with mastoid bones, .....	4.55	0.115	3.0	0.076	4.85	0.122
Breadth of occipital condyle, .....	1.3	0.032	0.9	0.022	1.20	0.031
Ditto of occipital foramen, .....	0.9	0.022	0.7	0.017	0.90	0.022
Depth of ditto, .....	0.65	0.016	0.45	0.012	0.60	0.015

It will be observed from the above that the fossil and the existing animal of 11 feet very closely correspond in dimensions, although the crotaphite foramina are rather larger, and the width of the bones in their neighbourhood greater in the fossil than in the existing one. This proportional excess of breadth however, is not so striking as in the measurements of the muzzle before given; although it still bears us out in the general expanded dimensions of the fossil animal.

Of the lower jaw the only comparative measurement that our discoveries have enabled us to make, is of a small portion of the anterior



extremity, shewing an extreme contraction and narrowness of the symphysis; that of the fossil being actually less than that of the existing 11 feet Crocodile. The form of the suture is similar in each, and the internal process equally well defined. 1.701

Further than from an inspection of the plates and description of the varieties of the Cayman and Crocodile, in the 5th volume of the Ossements Fossiles, I am unacquainted with the form of any other head than that of the Crocodile which inhabits the Ganges and Jumna rivers in this part of India, and presume that I am correct in placing our existing animal amongst the Crocodiles "à deux arrêtes." The peculiarities of the skulls in my possession resemble those of this species, although there is a point relating to the ridges, which may as well be noted, more especially as the same feature is most prominently marked in the fossil, thereby assimilating our existing and fossil animal still closer to each other.

The ridges (in *C. Biporcatus*) are described as "proceeding from the anterior angle of the orbit and descending in almost a parallel line along the muzzle, and gradually disappearing." In both the fossil and existing specimens now under description the above note applies distinctly, with this exception, that the ridges partially disappear at a point half way on the nasal bones, from whence they strike off in an oblique direction right and left towards the alveoli of the 10th tooth, this oblique ridge shewing itself as prominently as that at the anterior angle of the orbit.

There is a general resemblance between the fossil and the head of the existing Crocodile which is striking. The rugosities and position of inequalities on the upper surface closely correspond; the cranial foramina, the number of teeth, the foramina in the upper intermaxillary bones for receiving the two front teeth of the lower jaw, the grooves for the 4th teeth of the lower jaw, and the general form of the nasal aperture, are features similar in both. We may therefore fairly conclude from analogy that the Crocodile now found fossil in the upper strata of the Sivális, is of a species closely allied to the present one, with the simple difference of possessing

greater width in its proportions: in which view we must be satisfied with establishing it as a fossil variety of the *C. Biporcatus* of CUVIER and the *C. Porosus* of SCHNEIDER.

In taking the numerical proportion of the fossils already found as a guide to that of the animals existing on this tract previous to the upheavement of the line of country, it would appear that the Mastodon and Elephant were the most numerous. 2, Ruminants. 3, Hippopotamus of varieties, the largest of which with six incisors, *He Sivalensis*, is in the greatest proportion. 4, Crocodile, Ghariál, and Tortoise 5, Rhinoceros, Hog, and Horse. 6, Carnivora. 7, Fish.

The remains of Saurian animals, although standing high on this list, consist chiefly of fragments of the osseous plates of the neck, vertebræ, detached teeth, articulating extremities of bones of the arms and legs, as well as other portions of the skeleton; while portions of the head have been rarely found. Those referred to in this note are very perfect: others are crushed and distorted; but the leading differences which have been adverted to, are fairly marked in all those that have come under my observation.

There appears to be a local disposition in the deposits of these remains as would be natural to expect on a varied surface of plain, forest, and marsh. The Mastodons, Elephants, &c., in great abundance at some points, give place to the Hippopotami and Saurian reptiles in others. At many places the latter, with the Tortoise, are totally wanting; at others, as in a stratum of an impure marle attached to this upper series where fresh water shells (chiefly like the unio of the present day) were found in great abundance, nearly the whole of the remains accompanying them were those of the Crocodile and Ghariál. In considering the length of the fossil species we see no signs of any thing beyond that of the animal now existing. The largest remain in our possession is a vertebra which is one third larger than that figured in the London Geological Society's Transactions amongst the Ava fossils, and described as the remain of an enormous animal: the vertebra abovementioned is either one of the dorsal or lumbar, but the

processes are broken and imperfect; the dimensions of the barrel or cylinder are as follows :

The measurements of the 3rd Lumbar Vertebra of the existing Crocodile are here given.	Existing Crocodile, 7 feet long.		Fossil.	
	Inches.	Mètres.	Inches.	Mètres.
Extreme length, . . . . .	1.4	0.036	4.9	0.124
Breadth under transverse apophysis, taking a mean measurement, . . . . .	0.95	0.024	3.5	0.089

Large as the fossil may appear, the animal to which it belonged did not in all probability exceed 25 feet in length—whereas the Gangetic Crocodile of the present day is said to arrive at the enormous length of 30 feet, and in the pages of the *Calcutta Journal*, an animal of 28 feet long is recorded as having been killed by a gentleman of the Civil Service, (I believe) now residing in Calcutta.

## THE FOSSIL GHARIAL

OF THE  
SIVĀLIK HILLS.

AMONGST the numerous remains of the Crocodilidean Saurians which have been found in such abundance from the oolite up to the more recent strata, it would appear that the greatest proportion has been allied to the *Gharial*,\* and that the existing Crocodile and Cayman have been almost without

\* The French mode of writing this word, *Gaviál*, appears to have originated in a misreading of the manuscript of some naturalist; the *r* and *v* being nearly similar in form. As *Gharial* is the correct native name, there seems no reason for perpetuating the misnomer.—SEC.

their prototypes. It is only in the strata above the chalk\* at Montmartre, and the fresh water formation at Argenton where remains have been found, which were considered by CUVIER as appertaining to the latter subgenera; in these strata however the remains of animals of this description are scarce, and in those still more superficial abounding in the remains of the larger mammalia, in Mastodons, Hippopotami, &c., where we might naturally expect to find the Crocodile, the remains of this family have hardly I believe been found at all.

Of the fossil Crocodile brought by CRAWFORD and WALLICH from Ava, and figured in the London Geological Society's Transactions, the drawings shew a much nearer approach to the living congenera, than had, up to the period of that discovery, been found; and although we are unacquainted with the geology of the country from which they were brought, the new varieties of the Mastodons, which appear to be common both to the Siváliks and the Irrawaddi deposits, may establish an identity between the two formations.

In the Siváliks we have upheaved alluvium; or debris from the great Himálayas upheaved at a considerable angle; at those points especially between the Jumna and Ganges rivers where the shingle and sand are the most developed, their appearance is similar to what we might imagine the beds of the present rivers to exhibit, were they to undergo a similar convulsion. The presence of the fossils has not been satisfactorily determined on the line between the Jumna and Ganges; those that have been already collected in such great abundance are from the prolongation of the same line between the Sutlej and the Jumna rivers. Up to the present time they have generally been collected from the slopes of the mountains, slips, water courses, &c. They have been dug out near the village of Deoni in the Náhan Raja's territory, but at this spot the position of the stratum from which they were excavated, was not satisfactorily determined. In the Ambwalla Pass

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\* In the London clay the remains of either the true Crocodile or Cayman with the concavo-convex vertebra are said to have been found, the species allied to *C. d. museau aigu*, vide Parkinson Int. Org. Rem. p. 387, and also the head of an Alligator in the London clay of the Isle of Sheppey, found in 1832.

however we had the satisfaction of finding a large fragment of bone in situ, in a stratum of sand stone rock, in the face of a cliff, terminating one of those tortuous little streams that drain the steep slopes of the mountains into the main channel. The sand stone stratum in which this was found was inclined as usual in an angle of from  $2^{\circ}$  to  $30^{\circ}$ —and the position of the fossil was perhaps 600 feet from the bed of the main river. In the present state of the enquiry this fact is interesting, for it appears that in the many slips that have been visited and most carefully examined, no fossils have been found actually *in* the rock, with the exception of the instances above mentioned. The fossils are evidently not confined to the sand-stone; the clays and clayey conglomerates have their proportion also.

Of the Crocodile of these strata I have attempted in the preceding section to shew as far as measurements and my limited means point out, that the main difference between the fossil and the existing animal of the present rivers is in the breadth; a difference that might tend to an opinion of its being allied to the Cayman, did not other more distinct characters separate it at once from that subgenus. In the *Gharial* now under review I am unable to recognize any difference from the living animal; and there are certain peculiarities about the external surface of the skull of the existing *Gharial*, in slight indentations and rugosities, which are singularly coincident with the fossil. The following measurements are taken from two recent skulls, one of an animal 10 feet 5 inches long, and the other 8 feet 8 inches long:—the measurements of the fossil, from a very perfect skull with the beak broken off, which is evidently the remain of a large animal.

UPPER JAW. Number of Teeth, 50.	Existing <i>Gharial</i> .				Fossil <i>Gharial</i> .	
	10 Feet 5 Inches long.		8 Feet 8 Inches long.			
	Inches.	Mètres.	Inches.	Mètres.	Inches.	Mètres.
Extreme length from point of muzzle to outer margin of occipital condyle, .....	22.7	0.577	19.5	0.495		
Breadth on the temporal bones at the articulation with lower jaw, ..	8.2	0.21	6.5	0.166		
Ditto on the 28th tooth, .....	4.3	0.108	3.4	0.086	9.3	0.236
Ditto on the 20th tooth, .....	1.95	0.049	1.5	0.038		

UPPER JAW. Number of Teeth, 50.	Existing Ghuriál.				Fossil Ghuriál.	
	10 Feet 5 Inches long.		8 Feet 8 Inches long.			
	Inches.	Mètres.	Inches.	Mètres.	Inches.	Mètres.
Length of intermaxillary on suture (below), .....	5.1	0.129	4.4	0.111		
Ditto maxillaries ditto, .....	8.8	0.223	7.9	0.200		
Ditto palatine bone ditto, .....	4.8	0.121	3.8	0.096		
Ditto sphenoid do. to anterior margin of foramen, .....	1.65	0.042	1.4	0.035	3. 7	0.081
Extreme breadth on pterygoid apophysis of sphenoid, .....	5.3	0.133	4.15	0.106		
Length from tip of muzzle to anterior of orbit, .....	16.4	0.416	16.4	0.366		
Ditto do. do. of lachrymal bone, ..	14.4	0.366	12.2	0.309		
Breadth of frontal between orbits at the junction with the anterior frontal, .....	2.4	0.060	1.95	0.049	4.9	0.124
Ditto of parietal bones between crotaphite foramina, .....	0 55	0.014	0.65	0.016	1.0	0.026
Length of external nostril, .....	1.1	0.027	0 85	0.021		
Breadth of ditto, .....	0.9	0.022	0.60	0.015		
Length of crotaphite foramina, or those in rear of orbits, .....	2.0	0.051	1.4	0.035	3.3	0.083
Breadth of ditto ditto, .....	2.15	0.055	1.6	0.040	3.8	0.096
Ditto of occipital condyle, .....	1.2	0.030	0.95	0.024	2.5	0.064
Length of occipital foramen, .....	0.9	0.022	0.80	0.020	1.4	0.035
Depth of ditto ditto, .....	0.65	0.016	0.45	0.012	0.9	0.022
Length of palatal sinus, .....	2.65	0.068	2.35	0.059	4.9	0.124
Breadth of ditto, .....	1.4	0.035	1.10	0.046	2.4	0.060
Length from point of muzzle to anterior extreme of palatine sinus, ..	16.45	0.418	14.2	0.361		
Length of upper table of cranium between the anterior margin of the orbits and the posterior mastoid apophysis, .....	5.8	0.147	4.7	0.120	10.4	0.264
Breadth of ditto ditto ditto, .....	6.0	0.152	4.7	0.120	11.4	0.289
LOWER JAW. Number of Teeth, 50.						
Length of symphysis, .....	15.1	0.384	13.1	0.332		
Ditto on prolongation to posterior extreme of articular bone, .....	10.7	0.271	9.3	0.236		
Breadth on articular bones, .....	8.6	0.218	5.8	0.147		
Ditto on 23d tooth, .....	3.0	0.076	2.5	0.064		
„ 15th ditto, .....	1.6	0.040	1.3	0.032		
„ 3d ditto, .....	1.55	0.039	1.3	0.032		
„ 2d ditto, .....	1.85	0.047	1.6	0.040		
„ 1st ditto, .....	1.4	0.035	1.2	0.030		
Length of oval hole at posterior extreme of dental, .....	1.35	0.034	1.3	0.032		
Depth of ditto, .....	0.6	0.0155	0.45	0.012		
Ditto of jaw on this oval hole, ..	2.0	0.050	1.5	0.038		
Ditto on the 15th tooth, .....	0.9	0.022	0.7	0.017		

This fossil is water worn, and some of the projecting bones, especially of the sphenoid, are mutilated at the extremities; but the general character of the head, and the form and position of the foramina, &c. appear to correspond completely with that of the existing *Gharial*.

There is no approach to any of the peculiarities pointed out by CUVIER in the Caen and other fossils. On the upper surface we have, in the frontal, the same concavity between the orbits; the same form of the crotaphite foramina, with the parietal surface between them of the same comparative width; the posterior frontal separating the orbit from the crotaphite foramina corresponds; the form of the mastoid bones both in themselves and at their articulation with the apophysis of the os tympani, strictly agree with the existing *Gharial* of the present rivers.—The same may be said of the lateral and lower faces, in the external widening out of the pterygoid apophyses, in the situation of the hinder nasal fossa; the elevation of the orbital edge of the pyal; with the deep emargination, the form and proportions of the jugal; with the temporal fossa, and the sharp elongated internal process of the squamous bone: the form of the palatine holes, and the relative situation of the teeth to these holes, are points all of which agree with the living animal!

The animal to which this fossil belonged was not quite 20 feet long—the complete head from the tip of the muzzle to the posterior margin of the occipital condyle being about 47 inches. The measurements which I have made of the existing *Gharial* shew the proportion of the head to the length of animal as 1 to 5.

The following measurements of another fragment, consisting of the anterior extremity of the beak or muzzle of the upper jaw will still further go to establish the resemblance.

	Existing Animal.				Fossil.	
	10 Feet 5 Inches long.		8 Feet 8 Inches long.			
	Inches.	Mètres.	Inches.	Mètres.	Inches.	Mètres.
Length of intermaxillary on suture below, .....	5.11	0.129	4.4	0.111	8.30	0.210
Breadth on 9th tooth, .....	1.55	0.038	1.25	0.031	2.70	0.069
Ditto 4th „ .....	2.00	0.050	1.60	0.040	3.40	0.086
Ditto 3d „ .....	2.20	0.055	1.80	0.046	4.00	0.101
Ditto 1st „ .....	0.70	0.017	0.60	0.015	1.40	0.035
Depth on 9th tooth, .....	0.90	0.022	0.70	0.017	1.40	0.035

The above is the remain of a smaller animal than the former one, shewing the alveoli and some of the teeth, as far back as the 10th, on each side of the maxillaries. A more perfect resemblance to the living animal than this could not well be conceived; and it moreover establishes, in the absence of a connected beak and skull, that the fossil animal had precisely the same number of teeth with the living species. The suture connecting the intermaxillaries with the maxillaries is fortunately strongly marked in the fossil; the posterior point of the suture occurring opposite the 9th tooth, exactly as it does in the existing animal. The teeth, the form of anterior extremity of muzzle, the outer nasal aperture, with the lower indentations, correspond in every way; and, to descend still further to minutiae, at the commencement of the suture connecting the intermaxillaries and maxillaries, at a point in the former bone immediately in front of the 6th tooth is a small hollow or indentation: this hollow exists in the same situation and bears the same form in our fossil *Ghariál*.

Of the lower jaw we have only an imperfect fragment of the two branches connected at the commencement of the symphysis:—from the extreme hardness of the crystalline rock in which it is imbedded, we are unable to see further than that the angle of these branches corresponds with the existing animal, a point however which is proved by the fragments of skull which are in our possession, and which, imperfect as they are at the muzzle extremity, shew distinctly the commencement of that tapering form which is peculiar to the *Ghariál* of the present rivers.

In volume 5, of the *Ossemens Fossiles*, CUVIER, in recapitulating the peculiarities and differences between the Crocodiles and *Ghariáls*, says of the latter “Les pterygoidiens forment au dessus des palatins des espèces  
“de grosses vessies renflées et ovales de la grosseur d'un œuf de poule,  
“au lieu d'une simple voute cylindrique comme dans les Crocodiles et les  
“Caïmans, &c.,” and then “Je n'ai point observé cette vessie dans le  
“petit *Gaviál*, mais je suppose d'autant plus qu'elle est un produit de l'age



“ que, dans les vieux Crocodiles des Indes, cet endroit est beaucoup plus renflé que dans les jeunes.”

These demi-cylindrical swellings are highly developed in the 10 feet 5 inches specimen of which the measurements have been given ; whereas in the smaller and younger animal measuring 8 feet 8 inches, there is no appearance of them ; the sphenoid portion lying under the palatine and extending up to the anterior frontal's apophysis, in a flat uninflated laminated bone. From the little difference that exists between the bones of the *Ghariál* and of the Crocodile, we are unable to separate the remains of one from those of the other ; a great quantity have been found, teeth, osseous plates, ribs, vertebræ, &c., the latter, having the concavo-convex body, and the sacral vertebræ, with their transverse processes compressed and cylindrical, agree in every respect with the existing animal.

*Northern Dob, October 1, 1835.*

Plates II. and III., lithographed subsequently to the printing of the above description, illustrate the Author's observations on the comparison of the fossil with the existing species of *Crocodile* and *Ghariál*. The necessary explanations are given on the Plates. SEC.

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III.

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N O T E

ON THE

F O S S I L   H I P P O P O T A M U S

OF THE

S I V Á L I K   H I L L S.

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BY HUGH FALCONER, M. D.,  
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AND  
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*Superintendent, Doáb Canal.*

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FROM the abundant remains of this genus that have been procured from the Siválíks, and particularly the perfect specimens now in our own possession, we are at no loss in recognizing the characters which distinguish the Siválík species so remarkably not only from the existing Hippopotamus of Africa, but also from the fossil species hitherto found and described.

The great point of peculiarity is, that the Siválík fossil has six incisors of a character peculiar to itself, independent of the form of cranium which differs very materially from other varieties. The numerous fragments in our collection enable the proportions of the bones of the head and face to be very tolerably ascertained; and these, added to three nearly entire skulls, one of which is that of an animal just approaching adult, and the other two of a more advanced age, are so perfect as to leave no doubt of the characteristic distinctions of one or more new species.

To the fossil variety now to be described, we propose the name *Siválensis*, a name so far applicable as attaching it to its locality and commemorating the region in which its remains have been scattered in such profusion.

In the African Hippopotamus figured by CUVIER and so fully described in the first volume of the *Ossemens Fossiles*, we find the incisors consisting of four slightly curved teeth in the upper, and in the lower jaw four straight teeth projecting forwards at an obtuse angle with the plane of the grinding surface, the two centre ones being of considerably larger proportions than the others, and being formidable weapons either for tearing the roots and weeds from which the animal derives its nourishment or for defence. In the fossil Hippopotamus before us these large and powerful teeth are replaced by others of a smaller size but in a greater number, there being no less than six, those in the upper jaw being slightly curved downwards, and those in the lower projecting forwards; the diameter of these teeth, which are cylinders with truncated ends, is less in the upper than in the lower jaw, and the central teeth may be considered as being in some degree larger than those on the right and left. When we advert to the uses to which the incisive teeth of this unwieldy animal are applied, the means of tearing up the food, and the sieve to cleanse that food afterwards;\* we see in this form of tooth, and this arrangement of the muzzle an adaptation to the wants as perfect as, although for defence less powerful than, in the existing species. With the six incisors our fossil animal has the canine teeth of the upper jaw with a uniform outline in transverse section, whilst

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\* Vide *Lancet* :—Prof. GRANT's *Lectures*.

that of the lower jaw is pyriform or pear shaped. The molars resemble those of the existing species, and are numerically the same, the first milk or deciduous tooth which, as in the Horse, falls and is not again replaced, is here also conspicuous.

In proceeding to a comparison between the fossil head and that of the Cape Hippopotamus, we are at once struck with the position of the orbit of the Sivalik fossil. Viewing it in profile, the orbit is considerably more advanced and the general contour of the head thereby modified ;—taking a measurement from the posterior extremity of the occipital condyle, to the anterior ridge of the orbit, and from that point to the front of the muzzle, we have in the existing animal a proportion of 3 to 5 and in the fossil 9 to  $13\frac{1}{2}$ , giving to the orbit of the latter a more central position on the face ; this peculiarity leads to the muzzle and the zygomatic arch being separated by a hollow much more abrupt and much shorter on its antero-posterior line than in the Cape Hippopotamus. The anterior termination of the zygomatic arch on the malar angle is more acute, and the general form of this arch more prominent. The temporal fossæ are longer, and the temporal apophysis in its descent to join the malar bone is slightly inclined forwards, placing the posterior angle of the zygomatic arch in a more advanced position and more in front of the occipital surface than in the existing animal. The occipital crest is also more elevated, and the general appearance differs, owing to this position of the orbit ; which, as will be naturally concluded, leads to a different proportion in the bones of the head ; those of the cranium being lengthened, whilst those of the face are shortened in proportion respectively. In the suture separating the temporal apophysis from the jugal, we see the same direction and inclination as in the existing animal.

We will here introduce the table of measurements in juxtaposition with CUVIER's of the Hippopotamus of the Cape, and of the European fossil.

<i>Dimensions of Skull.</i>	<i>Existing Hippopotamus.</i>		<i>Fossil Hippopotamus.</i>					
	<i>Africa.</i>		<i>Europe.</i>		<i>Siválik 1st.</i>		<i>Siválik 2d.</i>	
	<i>Inches.</i>	<i>Mètres.</i>	<i>Inches.</i>	<i>Mètres.</i>	<i>Inches.</i>	<i>Mètres.</i>	<i>Inches.</i>	<i>Mètres.</i>
Length from the posterior surface of occipital condyle to the alveolus of the middle incisors,	....	....	....	....	....	....	22.6	.566
Length from the upper margin of one orbit to the other, to the rear, ....	9.85	.249	11.85	.300	....	....	12.4	.315
Ditto greatest width of zygomatic arches, ....	15.75	.400	17.7	.450	....	....	14.4	.366
Width of head over the suborbital foramen, ....	4.75	.120	5.7	.145	3.75	.095	4.34	.110
Height of ditto ditto from the border of alveoli, ....	5.1	.130	6.3	.160	4.45	.114	5.3	.134
Distance of posterior extremity zygomatic apophysis of malar from suborbital foramen, ....	10.65	.270	13.4	.340	....	....	11.25	.285
From ditto to the middle of occipital crest, ....	10.25	.260	12.6	.320	....	....	10.25	.260
Antero posterior diameter of orbits, ....	2.8	.070	3.55	.090	2.30	.058	2.63	.067
Greatest interval between inner side of zygomatic arch and surface of cranium, ....	5.1	.130	5.1	.130	....	....	3.8	.096
Height of head from posterior border occipital foramen to top of occipital crest, ....	5.5	.140	7.5	.190	5.7	.144	6.8	.173
Width of head between inferior angles of occipital crests, ....	11.0	.280	12.8	.325	8.8	.224	9.7	.246
Length of occipital foramen, ....	2.0	.050	2.6	.066	2.0	.050	2.48	.062
Width of ditto, ....	1.6	.040	1.6	.040	1.3	.032	1.5	.038
Length of line of molars, ....	10.25	.260	11.85	.300	10.5	.266	9.48	.240
Distance between alveolus of first molar and canine, ....	4.3	.110	6.7	.170	....	....	1.4	.035
From summit of occipital crest to alveolus of middle incisives, ..	25.2	.640	29.9	.760	....	....	23.15	.588
From ditto to anterior margin of orbit, ....	....	....	....	....	9.0	.228	10.2	.250
From anterior margin of orbit to alveoli of middle incisive, ....	....	....	....	....	....	....	12.4	.314
Vertical diameter of orbits, ....	....	....	....	....	2.1	.06	2.3	.058
Interval between alveolus of first or deciduous molar and middle incisors, ....	6.8	.170	8.3	.210	....	....	3.8	.096
Width of cranium in rear of the frontal angle, ....	....	....	....	....	3.7	.093	4.4	.112

The Siválik fossil noted as No. 1 is a perfect skull with the exception of the incisive bones, and fortunately exhibits the sutures on the upper surface ; a second specimen consisting of the occipital and parietal regions with the frontal as far forward as the front of the orbits ; and a third fragment consisting of the incisive bones and teeth with the anterior extremity of the nasals and maxillaries, are those from which we draw a comparison on the bones on the upper and lower surface, and on the form and position of the molars.

On the upper surface of the fossil the chaffron instead of running in a flat line slightly concave as in the existing animal, is considerably depressed in the region between the orbits, the superior ridges of which are elevated in proportion, and stand considerably forward on the cranium. From the remarks on the elongated form of the temporal fossa it may be hardly necessary to advert to the similar extension of the sagittal crest, which is proportionally longer, and more marked, with a greater elevation at its junction with the occipital. The broken and fractured boundaries of the nasal aperture in all our specimens of skulls, will not admit of our measurements extending to that point, but we are able from a fragment above referred to, containing the incisive bones and nasal aperture, to note, that the nasal bones are advanced as far forward as those in the living animal, so that a straight line touches their anterior extremities drawn from the front of the canine alveolus on one side to that on the other. The nasal bones do not expand so much towards the rear as in the existing Hippopotamus, and that part connected with the frontal is more blunt and rounded ; the distance between the nasal bone and the orbit and the lachrymal juncture is comparatively larger. The lacrymals descend upon the jugal much the same as in the existing animal, but they appear to advance considerably more forward on the face, the anterior extremity in conjunction with the nasal and maxillary being exactly over the last vicarious molar, whereas that figured by CUVIER represents this point as over the second true molar. The suborbitary foramen is also more advanced and the hollow in which it is situated, formed by the bulge of the jugal and

canine alveolus, is as we before remarked more abrupt. The figure of the muzzle is very similar to the African variety, with a modification in the form of the incisives adapted to the particular form of the teeth. The width of the muzzle is comparatively greater, but the separation of the whole into four bluff swellings with the spaces intervening for the incisive sutures, is a point which has a close resemblance in the existing animal.

The frontal angle is more acute in the fossil ; the coronal crest runs more obliquely backwards, and the antero-posterior length of the frontal is twice as much as in the African. From the rounded form of the nasal suture in its contact with this bone, the anterior part of the frontal forms a tongue bounded by the lachrymal in front and by the nasal and orbit on the two sides. From the depth of the temporal fossa, as in the existing animal, the width of the cranium is somewhat less than that of the muzzle over the suborbitary foramina, and the interval between the inner side of the zygomatic arch and the surface of the cranium is somewhat less than the width of the cranium.

On the lower surface we are unfortunately not so well provided with sutures to guide us in our comparative dimensions ; for, with the exception of those between the lines of molars which are in themselves not very distinct, there are none whatever. The position of the bones in rear of the palatal sinus appears to correspond with that of the existing animal, although the relative dimensions and proportions will, it is supposed, be modified by the peculiarities described in the upper surface, and dependent on the lengthened form of this region. The basillary mastoid apophyses, and the slightly concave surface of the glenoid cavity, appear to resemble those of the Cape Hippopotamus ; this latter cavity is more in rear of the most salient projection of the zygomatic arches than in the living animal. In the form and position of the molars the only remark that may be made is on the non-parallelism of the lines : CUVIER describes those of the Cape Hippopotamus as parallel but slightly curving outwards towards the front (*un peu écartées en avant*) ; we see some difference in our different specimens, but in all, there is a curving outwards both in front and rear, the middle of the palate being the

most contracted. This curving outwards is most shewn towards the front where the lines of molars appear to attempt a parallelism with the outer line of the maxillary bone, instead of running parallel to each other. The space between the most advanced molar and the canine is very much smaller in the fossil than in the existing animal, a point that may depend perhaps on the substitution of the six small incisors requiring but small alveoli, for the large ones (especially the two central) require a much larger surface and a much greater depth to admit of their being securely fixed. The palate is, as in the living animal, marked by a deep fissure in front, between the incisive bones ; and the suture appears similar ; but this is not very distinct in the fragment from which we draw our comparisons ; the two incisive holes are very distinct, but those referred to by CUVIER as commencing on the edge of the maxillaries in a small channel and terminating on the incisives by another hole, are not so distinctly marked, although it is by no means improbable that in clearing the fossil which is imbedded in a hard and crystalline sandstone, the two holes have been made into one ; we have before noted the fissure separating the incisive bones, and those (not so strongly marked but equally open outwardly) of the junction between the incisives and maxillaries, or that space between the canine and the third incisive. The extremity of the muzzle in front of the two canines, forms part of a circle ; if this segment be divided into seven equal parts, and one part given to each echancrure (of which there are three), and two parts to each of the incisive bones containing the alveoli of the incisors ; a tolerable idea of the proportions of this region will be obtained. The incisors of the upper jaw as before remarked are in diameter smaller than those of the lower ; they project but slightly from the alveoli, are directed downwards, and obliquely truncated on their internal faces.

It now merely remains with us to compare the occipital face with that of the African animal which may be best done by a reference to our table of measurements. We note however the great difference in the proportions in breadth to height, which in the above animal are as 2 to 1, whereas in the



Siválík fossil the proportion is as 3 to 2, shewing as was before remarked an increased height of the occipital crest.—To proceed therefore to the lower jaw :

In comparing the lower jaw with that of the existing animal, independently of the additional incisors, we have a marked difference and distinction in the form of the ramus, the enormous descending process of which is if any thing more extravagantly developed. This strange appendage peculiar to the genus, and formed for the attachment of the masseter and temporal muscles is here of a form less tapering and more deep and massive in its proportions than in the existing animal ; the posterior margin is more round and the anterior, or that descending from the base of the maxillary bone, which in the existing animal is curved and pointed forwards, is here blunt and unmarked by any peculiarity of form. This angle is inclined outwards, and the outer surface is as depressed for the reception of the muscles as that of the living Hippopotamus. We observe no increase of height in the coronoid process, but it differs from the living animal in not being projected so much forward. There appears to be no difference in the condyles nor in their position with reference to the form of the jaw ; the line of the grinding surface (the specimen from which we draw this description is a lower jaw joined at the symphysis, and only broken at the posterior extremities) is inclined to the outwardly curved direction, described as a peculiarity in the upper surface : the teeth do not appear to differ from those of the animal now living, but the space between the front molar and the canine is, as in the upper jaw, more contracted. The canines protrude from the alveoli considerably, in a curve slightly inclined backwards at the point, which is obliquely truncated on the internal surface, from the root or point where it leaves the alveolus to the tip. The space for the incisors and the incisive teeth themselves differ as was before remarked, from the existing animal, the large central incisors of which are here replaced by much smaller ones. The number of incisors in the fossil is six, of nearly equal dimensions, cylindrical, inclined outwards at an obtuse angle to the plane

of the grinding surface, and sharply truncated at the internal side at the point. In taking the dimensions of the incisive teeth of the upper and lower jaw from two specimens of adult animals we find their proportions as follows :—

	<i>Inches.</i>	<i>Mètres.</i>
Diameter of incisor—upper jaw, .....	0.9	0.022
Ditto ditto—lower ditto, .....	0.7	0.018

If there is any fixed difference in the size of the teeth of each jaw, it exists in the second incisor being a little less than the others. It may be necessary to note here with regard to the number of molars in the lower jaw, that amongst the great number of specimens before us of animals of all ages, we see no mark or vestige of the first milk tooth, or that which, as was mentioned before, falls and is not replaced ; and the space between the adjacent molar and the canine is so contracted as hardly to admit of room for another tooth ; but as this tooth exists in the upper jaw in every specimen in our possession, we may infer that its non-presence in the lower jaw is accidental. In viewing the lower jaw in profile, we see that the anterior angle below the canines is somewhat more abrupt, and more inclined to the form represented as belonging to the European fossil species, the depth of the inferior maxillary is more regular, and the form of the posterior branches as before described, very different. The lower surface exhibits a width of symphysis equal to that of the living animal, and the angle formed by the branching off of the two sides is also similar. The width across the muzzle from the exterior side of the canine alveolus to the other is comparatively greater in the Sivalik fossil, and the extreme width of jaw, over the penultimate false molar, less. It will be seen that these differences of form correspond with those of the skull ; the advanced position of the orbit and the contraction of the sinus in which the infra-orbitary holes are situated, leading to a modification in the whole form of the grinding surface.

Having made the comparison with the Cape and existing Hippopotamus, we will cursorily note the differences that strike us when comparing

it with the fossil described by CUVIER as belonging to the cabinet of the Grand Duke of Tuscany and figured in the first volume of the *Ossements Fossiles*. The distinctive differences will be perhaps best observed by a reference to the table of measurements : we see however that our fossil in the gradual slope of the malar process towards the cheek corresponds ; but differs completely in the hollow formed at this point between the jugal bone and canine alveolus which in our fossil is more abrupt and marked. The length of the parietal region of the European fossil is even less than that of the existing animal, and their proportions relatively with the bones of the face less. In the Sivalik fossil, the advanced position of the orbit completely modifies the whole form, and, by equalizing the proportions of the anterior and posterior divisions, gives a new style of appearance to the cranium. In the fall of the occipital crest towards the region between the orbits, and a consequent increased height of occipital surface, the Sivalik and Florence fossils also agree. In the proportion of the frontal surface to the area of the rest of the skull the resemblance also holds good ; but we have the same difference in the relative position of the canines to the molars ; the Florence and African species corresponding in this respect. The grand distinction of the incisives and canines, both in form and number, is peculiar to the *Hippopotamus Sivalensis*. In the lower jaw the space between the two branches, and the angle which is internally formed by them does not resemble that of the Florence fossil ; but, as we before remarked, is more assimilated to that of the existing animal in being round at the angle, and the whole interval space being more open : the descending process of the ramus differs, as explained before ; and the form of the anterior angle of the jaw below the canines is somewhat similar and not so gradually rounded off as in the living animal. The difference in size and number of the incisors leads to a difference which, as before noted in the comparison with the living animal, needs not be made the subject of further remark here.

With the *Hippopotamus Sivalensis* and that figured in the *Reliquiæ Diluvianæ*, described as found in a peat bog in Lancashire, and of which

a drawing is given in Professor BUCKLAND's work alluded to, little resemblance is recognizable. The Lancashire fossil has the four incisors, with a lower jaw of proportions apparently quite unique, and with a prominence of arch in the nasal bone equally so. We may however remark the elevated occipital crest, and the fall towards the space between the orbits which exists in the Lancashire fossil, as this appears to be general to the fossil species, relieving the head from that straightness of chaffron which is noted as one of the peculiarities of the African Hippopotamus.

Having concluded our remarks regarding the Hippopotamus Sivalensis, we now come to another and a smaller species of this genus which appears to have been less numerous, but with the remains of which we are sufficiently provided, although in the possession of only two fragments; one the imperfect skull of an old animal with the teeth much worn; and the other the right side of the lower jaw, shewing an unusual contraction or narrowness in the symphysis; this latter fragment contains five molars, the rear one perfect, and the last false molar sufficiently marked to establish the age of the animal; this was past adult, the first and second advanced cylinders of the rear molar being worn, and the third or rear one in the state of germ, but fully out of the alveolus. The form of this tooth differs from the great Hippopotamus in the absence of the trefoil, the wear of the coronals of each pair of collines taking a crescentic form outwards, not unlike that of ruminants, the grinding surface sloping outwards, very similar to the description given by CUVIER of the Hippopotamus Minutus. The form of the jaw, however, is peculiar, the marked features consisting of a general slenderness of proportions, and an inequality in the depth, which being contracted at the point of the descending process, gets gradually deeper, and diminishes again still more gradually up to the symphysis: in the great Hippopotamus we have a straight, thick, massive jaw. The foramen for the artery distinctly exhibited in the fossil, enters just behind the last tooth on the internal face of the ramus, and shews itself again on the opposite side just between and under the fourth and fifth molar, in a markedly large hole from which, to

the space between the tusk and the most advanced molar, there is a deep channel or indentation running upwards in a curved line parallel to the lower face of the jaw. The anterior and posterior portions of this beautiful fragment are unfortunately wanting, but a small part of the symphysis, at which point the fossil terminates, is distinctly marked, as well as the transverse section of the canine or tusk which as in the large animal is pear-shaped. A considerable portion of the anterior extremity is wanting, and with the tusk the fracture shews only one alveolus or hollow for an incisive tooth: the existence of two, however, can hardly be doubted, but the narrowness of the front may make a greater number than four between the two canines problematical. The ramus of this specimen is strongly marked on its anterior part by an elevated ridge pointing angularly forwards, and pushing forward a nearly flat surface to the centre of the rear tooth; the descending process is unfortunately too much broken to allow of our speaking decidedly, but the angle of departure from the straight line of the jaw is abrupt. The other remains of this smaller species to which we have alluded, consist of a skull, the front and rear of which is broken off, and one line of molars with the palate only perfect. The superimposed cranium would appear to be contorted by pressure, as is by no means uncommon, but this circumstance would lead us to refrain from an attempt at characterizing its peculiarities. The molars consist of the three rear permanent ones, and the last false molar, this latter one exhibiting the crescentic form of wear on its coronal surface described as peculiar to the first fragment. The other molars are much worn, and therefore with the exception of the encircling ridge of enamel, we have but those flexures which would have brought us to a correct conclusion. These molars are remarkably broad in proportion to their antero-posterior dimensions, and have an oblique grinding surface as before described in the other fragment. We may remark, that should these two remains belong to a small Hippopotamus of the same species, the great difference in the breadth of the grinding surface in the upper and lower jaws, as marked as is in the Rhinoceros,

would establish a species with (in this respect) rather unusual peculiarities. To this smaller species we propose the name of *dissimilis*, from the differences of form from the rest of the genus.

From the above additions to the species of the Hippopotamus, and from the marked distinctions in the incisive apparatus of the *Hippopotamus Sivalensis*, we shall perhaps be justified in at once establishing a new subgenus in this genus of mammalia, fixing the subgeneric characters on the incisive teeth. So marked a distinction in the form, number and character of the incisors will we imagine admit of such an arrangement, with every advantage to science, and in taking this step we place the new subgenus in the following position and order :—

Genus—HIPPOPOTAMUS.

1st Subgenus—HEXAPROTODON.

1. Species, *H. Sivalensis* (NOBIS.)
2. „ *H. Dissimilis* (NOB.) an hic, vel infrà, potius referendus ?

2nd Subgenus—TETRAPROTODON.

1. Species, *H. Amphibius*.
2. „ *H. Antiquus*. (Cuv.) fossil.
3. „ *H. Minor* (Cuv.) fossil.
4. „ *H. Medius* (Cuv.) fossil.
5. „ *H. Minimus* (Cuv.) fossil.

The specific characters of the first species of our new subgenus being as follows :—

Genus—HIPPOPOTAMUS.

Subgenus—HEXAPROTODON.

Species—SIVALENSIS.

Char. *H. dentibus primoribus utrinque sex, subæqualibus; laniarils difformibus: superioribus nempe quoad sectionem transversalem reniformibus: inferioribus pyriformibus; cranio elongato; oculo ad medium caput ferè attingente; facie ad latera valdè sinuatâ.*

Before closing this paper, we may make a few general remarks on the remains of this genus, which, with the exception of the Mastodons and Elephants, are by far the most numerous.

As may be imagined in such an extensive collection we find the remains of animals of all ages, with teeth in every variety and state of detrition ; from the young animal with the complicated and triple cylindereed milk tooth, to the old and worn-down molar without any mark of the trefoil, and with a simple encircling ridge of enamel. In the fossil skull described as approaching adult (from which the measurements noted as No. 1. have been taken) we have a beautiful exhibition of the teeth in that state when the animal has just lost its last milk tooth, and the new molar or '*dent de remplacement*' is just shewing itself in germ, whilst the last permanent molar, or that most posterior, is in the same state of advancement, having just pierced the bone : the oldest tooth in the head or the first permanent molar is just worn to that state, when the development of the trefoil crown is most perfect ; the second permanent molar is just shewing this appearance on its two front pillars ; the front false or pointed molars are unworn, and exhibit in all their perfection the richly embossed surface, which is peculiar to these teeth in the Hippopotami. The first false molar or milk tooth seems to have retained its position in many of our fossils long after the fall of the other milk teeth, and long after the arrival of the animal at the adult state. In some of our skulls which are the remains of very old animals, we observe the alveolus of this tooth very distinct, and having the appearance more of having been broken off in the fossil, than of having been lost previous to the death of the animal, in which case moreover a filling in of the pit from the growth of the bone would be more or less evident in the fossil. From the natural wear of the tusks upon each other, the truncated extremity of the upper one, and in the Hippopotamus Sivalensis that which is described as reniform, occurs on the convex or outer side of the tusk ; and this must be the case wherever the tusk belongs to the upper jaw. Amongst a very extensive and very large collection, containing as we before remarked three perfect skulls, with a number of fragments of nearly perfect lower jaws, with a great number of pieces of both more or less mutilated, the reniform tusk is an invariable appendage to the upper, and the pyriform to the lower jaw.

Our collection however exhibits one solitary instance of the anterior extremity of a reniform tusk truncated on the inner or concave surface; this unfortunately is a separate fragment, and unattached to any portion of the jaw, and bearing in itself no further mark of its having existed in the *lower* jaw than this truncation of the extremity. It is difficult to imagine any fortuitous circumstance that would have produced such an anomaly, and it is at the same time difficult to come to a conclusion contrary to the facts elicited by such an extensive collection of remains, in which we see no sign of the reniform character of the canine in the upper jaw; should the truncation alluded to *not* be accidental, or caused by some deformity in the position in the alveolus, we have yet to discover a variety of the Hippopotamus with the reniform tusk in the lower jaw. The fact of the existence of this fragment however may be as well noted; as we observe peculiarities of form in other fragments of the bones of the head that may ultimately prove to belong to different species. We have contented ourselves with drawing our comparisons from the bones of the head, without any reference to the osseous structure generally of the animal, in which our collections however abound, especially in vertebræ, and the solid articulating extremities of the bones. A more lengthened period of search and examination, will add much to the value of an enquiry upon this point, and a comparison with the actual bones of the Cape Hippopotamus instead of with CUVIER's drawings, will render any attempt at a discrimination of existing differences, easier, and when completed and worked out, doubly valuable.

*Northern Doab, November 15, 1835.*

NOTE.—At the time of ordering this article to press, (25th January 1836,) the drawings of the varieties of Fossil Hippopotamus in the Museum of Messrs. FALCONER and CAUTLEY have not reached the Society. The omission is however in a great measure supplied by the drawings of the specimens in the *Dadpur* Museum of Lieutenants BAKER and DURAND, presented to the Society by the latter Officer, which are published, together with his descriptive Note, in the following article. SEC.



## IV.

## SPECIMENS

OF THE

## HIPPOPOTAMUS AND OTHER FOSSIL GENERA

OF THE

## SUB-HIMALAYAS

## IN THE DĀDŪPUR COLLECTION.

BY LIEUTENANT H. M. DURAND,  
ENGINEERS.

THE discovery of the existence of fossil organic remains in the vicinity of the village of *Rayawāla* and in the *Marakanda* pass, has led to the examination of the tract of tertiary hills lying between the river *Jumna* and *Pinjor*. From different parts of the line specimens have been obtained, and the fact of its richness in such relics fully established.

The greater number of the specimens in the *Dādūpur* collection are from the hills lying between the *Marakanda* pass and *Pinjor*; the calcareous sandstone prevalent in these formations has usually afforded them; an exception however occurs in the neighbourhood of *Dudgehr*, when the matrix, instead of sandstone, is a red indurated marl in which not only the remains of mammalia and reptilia are found, but those of mollusca also. The native collector reported them to occur together, and along with the shells produced fragments of bones and vertebræ of *Saurians*. Having had no opportunity of visiting the place, I can neither corroborate his statement, nor particularize the site of the deposit. The shells appear to belong to

fresh-water species ; they are not abundant and are generally in a bad state of preservation. The red marl is with difficulty disengaged from the specimens, any attempt to separate the shell from the matrix being usually at the expense of the epidermis, and too frequently at that of the valves themselves.

The varieties are few in number, but the determination of fossil species requires so much experience and nice discrimination that no apology will be requisite to excuse silence on this interesting point. A selection which is to be placed at the Society's disposal, will it is hoped afford the means of determining the question.\* The univalves bear a small portion to the bivalves, being on the ratio of 1 to 100 ; it must however be remarked that the quantity hitherto collected being small, the above proportion might be materially affected by an inconsiderable increase to the number of specimens.

The same remark is applicable to the result deduced from the number of upper and lower jaws, or portion of jaws at present in the collection ; the proportion of the *proboscidia* to the *pachydermata*, properly so called, is in the ratio of 3 to 1—that of the *proboscidia* to the *ruminantia*, 5 to 1. Both proportions may be expected to vary considerably in the course of future researches.

Many of the specimens have undergone fracture since they were imbedded in their present matrix ; some are much distorted ; and a few are crushed. The Hippopotamus' upper jaws have in consequence of their shape, been frequent sufferers : out of eight upper jaws more or less complete scarcely can two be called straight ; the remainder are crooked. Illustrative of the effect produced on some of the relics is the sketch fig. 11, Pl. VII. This horn evidently must have undergone fracture when imbedded ;

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\* Some of them are figured in Pl. XLVIII. figs. 45, 46, 47, 48 of the *Journal of the Asiatic Society*, vol. IV. They resemble precisely the shells transmitted from the Prome fossil field in Ava, by Lieut.-Colonel BURNEY. SEC.

the pressure of the circumjacent sandstone has kept the splinters in their places until they were cemented together, as at present. When adverting to any of the accompanying sketches I shall notice those which have suffered.

I may here remark that the following brief notes and their accompanying sketches, are forwarded with the view of filling up any hiatus which may be found amongst the Hippopotamus remains, transmitted by Colonel COLVIN, to the Asiatic Society; and of bringing part of the *Dádúpur* collection to notice when his valuable despatch is examined and classified.

#### HIPPOPOTAMUS—LOWER JAWS.

Fig. 1. Pl. IV, is the lower jaw of a full grown animal; the small anterior molars are absent, the posterior molars much worn; the junction of the two halves of the jaw presents a curve of much regularity; the narrowest part of the jaw occurs at the third molar, or at the second if the advanced ones be not counted; the exterior curve of the maxillaries both anteriorly and to the rear is bolder, giving a longer versed sine than observable in CUVIER's plates of the existing and fossil species described by him: the base line of the incisor teeth, or that at which they protrude from the jaw is in a line with the centre of the canines, so that taking a side view their protrusion from the jaw is not seen.

Fig. 2, Pl. IV, is from a specimen in the possession of Conductor DAWE which doubtless belonged to a younger and smaller animal than the former. One of the 1st molars is present; the 6th and 7th are little worn. The incisors are nearly equal in diameter; the right central one presents a worn angular surface, produced it may be supposed by an upper incisor.

The above specimens appear to be of one species.

Figs. 3 and 5, Pl. IV, are mere fragments, interesting however from the shape and striæ of the canines, and the proportion of the diameters of the incisors amongst themselves. The centre ones are the largest; those next to

them the smallest, and the exterior ones hold a mean between the two. No whole jaw of this description is in the collection, and the fragments are such as not to warrant any deductions from the distinctions here noticed. Fig. 4, Pl. IV, presents a marked difference in the shape of the incisors, which are more elliptical than in the preceding varieties. The exterior incisors have a section not observable in any other specimen; and are, relatively to the four centre incisors, set lower than the analogous incisors of other varieties—may not this be considered a distinct species?

Fig. 3, Pl. V, is a fragment from the lower jaw of a small Hippopotamus, it contains the two posterior molars, the advanced one differs in shape and proportionate dimensions from the analogous molars of the larger species; the fore part of the tooth is much narrower than the after part; the length of the tooth measured along the jaw is equal to that of the same tooth in the larger species, the jaw is more curved and fines off more rapidly towards the front than in the larger animals: it is so narrow in front of the advanced tooth as to suggest the possibility of their having been fewer molars than seven.

#### HIPPOTAMUS—UPPER JAWS.

Fig. 1, *a*, *b*, Pl. VI, is from the head of an old animal, the teeth being very much worn: the specimen is so much cracked, that the sandstone could not be cleared from the temporal fossa. On comparison with the species described by CUVIER many differences may be observed. I shall however confine myself to noticing a few distinctions which exist among the specimens before me, without alluding to those which will immediately strike the eye on comparing CUVIER's plates and the accompanying sketches.

Fig. 1, Pl. V, is taken from a specimen, the head of an adult animal; it varies from the former in the shape and prominence of the orbits, in the

greater concavity of the head between the orbits, and the more rapid rise of the ridge : this specimen is also much cracked and consequently could not be altogether cleared of matrix.

Another specimen in our collection (omitted for want of room in the engraving) has, in general form and degree of preservation, a resemblance to Fig. 1, of Pl. VI. It is from the head of an aged animal : the roots of the canines are visible and present a heart-shaped section. There is however much difference between the two ; the most striking dissimilarities are the insertion and start of the canines, which attest shorter nasal bones to have belonged to this species ; the shape and prominence of the orbits ; and the greater concavity of interorbital space. The specimen under consideration, has a nearer resemblance to Fig. 1, of Pl. V, but belonged to a somewhat smaller animal.

Fig. 2, Pl. VI, is given as shewing distinctly the sutures, which disagree in several points with those of species hitherto described, both as existing or in a fossil state.

Fig. 1, Pl. VI, may be considered as one species ; Fig. 1, Pl. V, and Fig. 2, Pl. VI, as having belonged to another species possessing the cardi-form canines of which so many fragments are disinterred.

Fig. 12, *a, b, c*, Pl. VII, belonged to a small Hippopotamus, and presents two peculiarities—1st, the great breadth of its ridge as shewn in Fig. 12, *a*. 2ndly.—The depth of its occipital condyles, which is greater in proportion to the height of the occiput, than those of the large Hippopotamus.

Fig. 12, Pl. VII, though possessing the peculiarities above noticed, affords too narrow grounds for the establishment of a separate species.

The lower jaws agree in one respect, namely that of all having six incisors, in this differing from the existing and fossil species hitherto described.

The upper jaws have the proportion between the external breadth of their occipital condyles and the breadth at their orbits similar to that

stated to exist in the living species by Dr. ADAMS, twice the occipital condyles' breadth equalling the breadth at the orbits.

Figures 2a, 2b, 2d, Pl. V, and Fig. 6, Pl. IV, are taken from a specimen which is the only one of the kind hitherto met with. It is a fragment from the jaw of some pachydermatous animal\* ; but differs materially from all with which it has been compared : further discoveries will it is hoped throw light on this interesting fragment.

Fig. 9, a, b, c, Pl. VII, is a fragment from the jaw of an animal supposed to belong to the genus *Sus*. (*Sus Sivalensis*, FAL. and CAUT.)

Fig. 6, Pl. VII, molar of a small Hippopotamus.

Fig. 7 and 10 a, b, molars supposed to belong to species of the *Sivatherium*.†

Fig. 8, a perfect tooth, the lower part of which has a white enamel ; the upper part is a dark brown cone, longitudinally striated—I have delineated it in consequence of its dissimilarity to the drawings or specimens of Saurian teeth which have come under my observation.‡

\* The drawing of this fragment so much resembled CUVIER's plates of the Hippopotamus, that I wondered at the author's misgivings on the subject, and wrote to interrogate Dr. FALCONER previous to putting the present page to press. Dr. F. however assures me that the fragment undoubtedly does not belong to that animal ; but, as Lieuts. BAKER and DURAND had rightly conjectured, to a new pachydermatous animal, to which Captain CAUTLEY and himself have from other specimens given the name of *Chærotherium* : "the engraving is imperfect, and so much like the Hippopotamus, that it might be easily mistaken. The difference in the original tooth however is well marked. There is no real trefoil on it ; the appearance is spurious : the plane of wearing is oblique ; the spur is strongly bifid ; and the collines or mamillary processes are wide apart." J. P.

† Dr. FALCONER remarks on the engravings: Figs. 10, a, b. "they exhibit the form well, but they do not give the characters of the surface of the teeth, which is striated reticularly with rugous eminences." A tooth of the same kind, obligingly sent down by dāk for my inspection, exhibits these peculiarities very distinctly ; I hope shortly to have an opportunity of engraving it.—J. P.

‡ *Croc. bispinatus* of the preceding paper by Captain CAUTLEY.

## V.

## INDICATION

OF A

## NEW GENUS OF THE CARNIVORA,

WITH DESCRIPTION OF THE SPECIES ON WHICH IT IS FOUNDED.

BY B. H. HODGSON, Esq.

*Resident in Népál.*

FAMILY CARNIVORA. TRIBE PLANTIGRADES.

GENUS URSITAXUS. MIHL.

*Cheek Teeth  $\frac{1}{2}$ : of ursine flatness almost, but musteline disposition;\* the tubercular of the upper jaw, smooth-crowned, narrow, parallelogrammic and smaller than the Carnivorous: none in the lower jaw: two false molars above and three below on either side: general conformation of the animal similar to that of the Badger, but wanting external ears: anal glands as in Mydaus.*

REMARK.—*The natural affinities of this Genus are with Ursus, Taxus, and Mydaus; but chiefly with Taxus.*

THE single animal from which the above characters are drawn was procured by me in 1829, since which period I have in vain endeavoured to obtain another: and, as I see no immediate prospect of better success in my search, I shall not longer defer giving such account of it as my materials

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\* That is, a disposition partially transverse, exhibited in the inner heel of the carnivorous tooth, and the whole body of the tuberculous one of the upper jaw. This arrangement of the teeth appears to be appendant to the true cutting type, and is not therefore developed in *Ursus*, or in other true plantigrades. Amongst the digitigrades it is common, and particularly so in the mustelidæ.

enable me to supply.\* The specimen I obtained was a mature male. It was recently killed, but had had the intestines removed before it was brought to me from the vale of *Muckwanpúr*, at the southern base of the last mountainous range towards India, whence I infer that its habitat is the hilly portion of the southern region of *Nēpál*.

*Species*—*URSITAXUS INAURITUS*. EARLESS *URSITAX*. *Mihi*.

This is a low-legged unwieldy massive animal, with the general conformation and size of the Badger, from which, however, it differs most materially in its system of dentition, and more obviously in the want of external ears, the harshness and scantiness of its single coat of hair, and the disposition and number of its palmary tubercles.

The Earless *Ursitax* or Bear-Badger is thirty-two inches from the snout to the root of the tail, which is five inches long, or six and a half if measured with the terminal hair. The girth of its body, behind the shoulder, is twenty-nine inches, and the massiveness thence inferrible is maintained uniformly throughout its proportions. It is purely plantigrade and fossorial, dwelling in burrows on the southern slopes of the hills, and very seldom appearing abroad by day. The face, though not elongated, is conic and suddenly sharpened towards a neat, round, immobile, clearly defined and ungrooved muzzle in which the nostrils are opened to the front, but have a narrow prolongation to the sides. The lips are closely applied to the jaws and entirely void of mustachios: nor are there any bristles on the cheeks, above the eyes or on the chin: the cheeks are full and fleshy: the head broad, and as much depressed almost as the Otter's: the eyes small,

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\* This animal is mentioned by the local name of *Bhārsiah*, in the catalogue of Nipalese Mammals, (1832); and its peculiar dentition is therein summarily described.



round, level with the cheeks, possessed of a third lid which may be drawn two-thirds over the cornea, and of a round pupil ; their position nearly equidistant from the snout and ear. The nude ears are shaped and disposed pretty much as in the human subject : but the helix is wholly wanting, being replaced by a marginal obtuse swelling of the skin merely. The parallel portion of the anti-helix is rather more sharply defined ; but the transverse is wholly absent : the tragus distinct, but the anti-tragus and lobe evanescent. The conch is elongated vertically like the rest of the organ, with but a small cavity and no superior definite limitation : the opening into the interior simple, apert, and round : the neck of the animal short and very thick : the body still thicker ; being as deep almost as the length of the limbs, which are short and powerful, particularly the anterior ones. The digits are 5 in all four extremities, blended with the metacarpal and metatarsal joints so as to constitute solid pads for the feet, the anteal half only of the last phalanges being free, and connected superiorly by a small strong membrane which is firmly attached to the nails. The inferior surface of the hands and feet, to the back of the wrist and to the os calcis is perfectly nude, the palms and soles being full, soft, and fleshy. At the forward end of each anterior digit is a very large ball, suitable to keep the huge nails from embarrassing the animal's walk ; but the *bases* of all the 5 digits rest on one, undivided, round, pad, behind which is another, as large almost, and of similar shape, for the metacarpi. The balls of the hinder extremities resemble those of the fore, save that the metatarsal pad lies less centrally behind the termino-digital one, and is somewhat less developed. The gradation of the anterior digits is thus : the central largest, then the index, next the annular, then the external finger, retracted as in our hand, and with its nail similarly diminished ; last the internal one, subremote as with us, but much the feeblest of all. The hind feet are considerably smaller than the fore : they have the external digits less retracted ; the talons of the whole much less developed ; more nearly equal

in size ; and gradated upon a different principle—the outermost being the stoutest, and the rest, gradually but trivially diminished in strength towards the inmost. The nails of the anterior extremities are typically fossorial, sub-arched, shallow, stout, obtuse, obliquely compressed with broad convex backs, and a sharpened edge below.

The feet and hands of *Ursitaxus* are precisely similar to the same organs in the Bears, except that the digit answering to the thumb is rather remote in our animal—not so in *Ursus*—and that the interval between the terminal balls of the digits and their confusion with the palmary mass is nude in *Ursitaxus*—clad with soft hair in the Bears.

The anal glands of the *Ursitax* differ considerably from those of the Badger, agreeing point by point with the same organ in *Mydaus* (Horsfield), save only that the excretory ducts are rather longer in our animal and have their termination in the rectum rather nearer to its orifice and to one another. The tongue of the *Ursitax* resembles that of the Badger, being wholly covered with small papillæ, neither horny nor aculeated backwards. The covering of our animal consists of harsh hair only, and that very scantily furnished. It is about two inches in utmost length, straight and adpressed, sufficient in quantity to hide the skin upon the superior aspect only of the head, neck and body ; the face, neck and body below, with the limbs internally, being partially nude. The colours are dirty yellow and black, clearly defined by a line passing from the brows along the flanks to the edges of the tail, and leaving all above it of the former—below it, of the latter, hue. The dirty tinge of the yellow upon the superior parts is caused by an admixture of yellow and black hairs, of which the former are more abundant and longer too than the latter, but both of similar harsh character. The tail, 5 inches long and scarcely reaching to the middle of the buttocks, is cylindrico-tapered and covered with hair like the back, the point being fine and a little recurved.

The following are the detailed dimensions of our animal—

	<i>Feet.</i>	<i>Inch.</i>
Tip of snout to base of tail, . . . . .	2	8
Tail only, . . . . .	0	5
Tail and hair, . . . . .	0	6½
Carpus (inclusively) to longest finger, . . . . .	0	4½
Heel to longest toe, . . . . .	0	4½
Length of the head, . . . . .	0	6⅜
Nose to fore-corner of eye, . . . . .	0	2
Thence to opening of ear, . . . . .	0	3¼
Girth of body, behind shoulder, . . . . .	2	5
Longest fore-nail, . . . . .	0	1½
Ditto hind ditto, . . . . .	0	0⅝

The skull is 5¼ inches long, 3⅛ wide and 2¾ high. The width is taken, not between the zygomatic arches but between the alæ of the transverse crista. There the lateral dimensions are largest owing to the great development of the transverse or lambdoidal ridge of the skull before it sweeps upwards to join the zygomatic arches. The skull bears, upon the whole, so great a similitude to that of the Otter, that it may be very well illustrated by pointing out the differences merely between the two. These consist in the slight arcuation of the outline along the parietal portion of the skull in *Ursitaxus*; the greater development of the frontal, nasal, and malar, bones; the diminished length of the zygomatic arches; the rather more incomplete and less advanced orbits; the very small size of the infra orbital foramina—which are besides two on either side—and, lastly, the larger development (½ more) of the tympanal bones. In respect to the teeth of the two animals there is no very noticeable difference in the incisors and canines which

indeed are apt to assimilate in most of the carnivora.\* The canines, however, are thicker, shorter and blunter in our animal than in the Otter. The molars, too, of both are formed upon the same ultimately sectorial model and have a similar arrangement in the skulls: but they are fewer in number in *Ursitaxus*; and the trenchant processes of the crowns are almost obliterated. And, as if to defy all exclusiveness of system on our part, the Otter, with its sharp processes, has a very large flattish heel to the upper carnivorous tooth, and an extremely broad transverse tubercular behind it. On the other hand, the heel of the same tooth in *Ursitaxus*, though flatter, is smaller; and the tuberculous tooth behind it exhibits a much less, but a smoother, surface. I regret that I have no Badger's skull wherewith to compare that of the *Ursitax*. Independently, as far as may be, of all comparisons the skull and teeth of our animal have the following characters.

*The Skull.* It is very thick and solid with numerous rugosities all over its surface; is rather depressed than compressed, and very slightly but uniformly arched along the vertical line: parietes amply developed, affording a large cerebral cavity and shallow temporal fossæ: the cristæ of medial height, but running unbrokenly from the bifurcation of the brows to the zygomatic arches; their chief development being at the point where they sweep round to join those arches: frontal bones of considerable length and width: nasal, short but wide: both slightly convexed across; and, lengthwise, the former convex, the latter, sub-concave: malar bones uncompressed, with two small infra-orbital foramina on either side: zygomatic arches, short, stout, considerably bulged outwards: orbits medial, very incomplete, there being no process from the zygoma, and but a small one from the os frontis: frontal sinuses medial or largish: occipital bones dipt vertically from the junction of the lambdoidal and sagittal sutures,

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\* In the form of the incisor teeth *Ursitaxus* differs entirely from *Mydaus* with which animal it has several points of affinity. Other differences occur in the structure of the ears and of the extremities—not to mention the cardinal distinction between the molar teeth of the two.

so that the condyles of the foramen magnum are neither postea nor antea to that junction. There is a short but strong vertical crista on the occiput, and a transverse one of much greater extent, parallel and closely approximated to the lambdoidal ridge. The bony separation of the cerebrum and cerebellum is very strong and much developed, leaving a long, elliptic, vertical foramen in the midst, nearly twice the size of the great foramen: the tympanal bones amply developed, semi-ovoid, and reaching forwards to the articulation of the jaws which is so complete, in the cylindrical hinge manner, that the lower jaw can be barely removed from the skull. The rami of the lower jaw are nearly straight, very powerful, short, uncompressed or remote, and furnished with large subvertical coronoid processes, and small styloid ones: the condyles nearly on a line with the upper cheek teeth.

*The Teeth.*—The incisors are all disposed rectilinearly to the front, erect, strong, cylindrical in their bodies, and broad-crowned; the crowns of the lower ones being horizontal—of the upper, obliquely sloped inwards. The external incisors are the stoutest, and the rest gradually decrease in thickness to the central pairs. These teeth are all in contact with each other; and, in lower range, with the canines also: but the front teeth of the upper jaw have a necessary interval from the canines for their passage. The canines are short, stout, obtuse, conic, and of equal size above and below. They are mutually scarped by friction against each other, but exhibit no keel. The upper canines are straight; the lower, subcurved. All the molars are in contact with each other, but not quite with the canines. They are sixteen in all—four on each side of either jaw, of which the two first of the upper, and three first of the lower range are false molars; the 3d above, and the 4th below, the carnivorous tooth; and the 4th above, the tuberculous one. Below there is no such tooth. All are disposed lengthwise, save the tuberculars of the upper jaw which have a transverse arrangement, causing a triangular vacancy between them and the internal

heels of the carnivorous teeth of the same jaw. The molars gradually increase in size as they recede from the canines in the lower jaw ; but, in the upper, the carnivorous tooth is considerably larger than the tubercular; which latter is of the form of an oblong, narrow, parallelogram, with a perfectly smooth concave crown. All the molars are fanged and essentially constructed as in the digitigrade or normal carnivora ; but, owing to the nearly obsolete development of the cutting processes of their crowns, they bear a character of greater resemblance to the molars of the typical plantigrades.

The scissor action or true cutting process must in respect to these teeth be limited to the carnivorous ones, and even there be more than matched by the crushing action of one crown on another. The whole of the molars are longer considerably than broad: but they are almost as evidently broader than high. Heretofore it has been remarked that in proportion to the diminished number of the molars is the high development of their sectorial attributes: but in *Ursitaxus* we have molars less only in number than those of the cats proper, which yet are distinguished for the remarkable flatness of their crowns.\*

Deeply imbedded in the cellular membrane at the outlet of the pelvis and centrally on either side the large anus, the *Ursitaxus* has an oblong, spheroidal, hollow gland, which communicates, by a distinct tubular canal, with a round pore opening on the caudal margin of the anus. Each gland is  $1\frac{1}{4}$  inch long and  $\frac{3}{4}$  wide, being large enough to contain a walnut ; and each has its own canal and its own pore. These pores or anal orifices of the glands are about  $\frac{3}{4}$  of an inch apart. The ducts uniting them with the glands take a superior direction to open at the upper margin of the anus,

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\* I make due allowance for detrition by use owing to the age of my specimen : but there still remains a remarkable flatness of crown in the molars, greatly exceeding that of the semi-frugivorous *Paradoxuri* for example. Such teeth, being only sixteen in total number, of which but two are tuberculous, constitute surely a singular and unique type amongst the Carnivora.

under the tail ; and they exhibit at either end a muscular ring. The walls of the glands are about  $\frac{1}{4}$  inch thick, and purely glandular ; and their lining membrane lies closely in contact with the walls and is secretory throughout. But no pores can be traced on this lining for exuding the secretion which yet is contained in the cavity of the glands whence it passes by the tubes and anal pores into the rectum. The secretion found in the dead subject was dark, thick, and very foetid.

*Nepal, February* , 1836.

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VI.

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NOTE

ON THE

EURINORYNCHUS GRISEUS:

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BY J. T. PEARSON, ESQUIRE,  
*Assistant Surgeon, Curator Mus. As. Soc.*

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*Class.*—AVES.    *Auctorum.*    *Ord.*—GRALIATORES.    *Ill.*

*Trib*————— ?    *Fam*————— ?

*Gen.*—EURINORYNCHUS.    Wilson.

*Gen. Ch.*—Bill, elongated, depressed, dilated at the tip, covered with feathers around the base. Upper mandible serrated along the middle of the roof of the mouth.

*Nostrils* entirely hidden by the feathers at the base of the bill.

*Legs* four-toed, three toes forward, and one backward ; cleft ; the hinder toe elevated, so that its tip alone rests on the ground ; toes margined along the sides, and furnished with short curved nails, of which that upon the middle toe has a sharp margin on its inner side.

*Tail* short, of twelve feathers, rounded.

*Wings* long, extending beyond the tail : first quill longest.



*Sp.*—EUR. GRISEUS. Wilson. (Plate IX.)

Eurinorynchus, grey above, white beneath, black bill.

*Platalea Pygmaea*, Linn. System. Nat. Edit. 12, vol. 1. p. 231, Gmel. Syst. Nat. Edit. 13, vol. 1. p. 615, Latham Gen. Hist. vol. 9. p. 7, Shaw Gen. Zool., vol. 11. p. 645, *Eurinorynchus Griseus*, Wils. Thun. Acad. Suec. 1816, pl. 6, (as quoted in Griffith's Regne. Animal, Edit. 1829,) vol. 1. p. 528, Griffith's Cuvier, vol. 8. p. 383, Temminck's Manual, vol. 2. p. 594.

*Sp. Ch.*—Size that of a sandpiper. Length, from tip of the bill to the end of the tail, 6 inches ; length of the bill  $\frac{6}{10}$  inch. Breadth, from tip to tip of the wings, 11 inches. Bill, both above and below entirely black, dilated at the tip to the breadth of  $\frac{4}{10}$  inch ; it consists at the base for two-thirds of its length of a central keel or ridge, flattened at the top, which is continued to the tip, and narrow margins, altogether about  $\frac{1.5}{10}$  inch in breadth : At the anterior third, the margins become dilated on each side, having a sharp angular projection in front, and the sides sloping off posteriorly so as to form a rhomboidal tip, the dilated part of the upper mandible being somewhat convex above, and concave below. Within the mouth, the upper mandible is margined all round the tip, and down the sides ; whilst along the middle there is a sulcus, corresponding to the keel above, furnished with small conical, sharp projections, to enable the bird to secure its prey. Under mandible in form like the upper, but with a somewhat smaller dilated end, fitting in when the bill is closed within the margin of its antagonist ; having a membranous fossa between the rami for two-thirds of its length, as far as their junction ; and from thence to the tip a central angular keel, or ridge, with the sides dilated like those of the upper mandible. Within the mouth the lower mandible is furnished all round with a slightly elevated margin ; and has a broad deep central fossa, for the reception of the tongue. In the dried specimen the tongue is black with a white tip, and it extends forward from the base of the bill  $\frac{6}{10}$  inch ; and appears to have been rather broad and fleshy, and as long as the bill.

The Pigmy Spoonbill is ash grey above, and white below, the ground colour being of a blueish ash. Crown of the head, back of the neck, middle of the back, upper tail coverts, middle of the tail, scapulars, greater and lesser wing coverts, and primary and secondary quills more or less of an ash colour, shaded with brown, and tipped with white. Feathers of the head, back of the neck, upper part of the back and wing coverts dark in the centre, and margined round the tips with white. Tail coverts darker, with white shafts for three-fourths of their length, and black at the tip, where the webs, also, are black. Tail  $1\frac{3}{16}$  inches long; shafts of all the feathers white, two central ones dark on the inner webs, lighter on the outer, and tipped with white; the other feathers gradually becoming lighter to the outermost one, which is almost white. Remiges with white shafts; webs dark brown, almost black on the outer one and tip; lighter on the inner; and white at the base for one-third of the outside, and two-thirds of the inside webs: First quill longest. Secondaries white at the base for two-thirds of the inner margin of the inner web, the rest dark brown, with a narrow border of white. Tertiaries still lighter, some of the inner feathers being altogether white on the inner web and tip. Lesser under coverts white, mottled with ash. Forehead, cheeks, throat, front of the neck and breast, inner coverts, sides, belly, and under-tail coverts snow-white. Legs and feet black.

The Pigmy Spoonbill is noted in Griffith's Cuvier as "one of the most rare birds existing, for, but a single individual is known." It is said to be a native of Surinam and Guiana. The present specimen is stated by Mr. NEWCOMBE, who presented it to the Society, to have been "shot on Edmonstone's Island, which is situated a little to the northward of the centre of Saugur Sand." Captain LLOYD, of the Indian Navy, informs me that he also once met with a specimen in Arracan.

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## VII.

## DESCRIPTION

OF

## THREE NEW SPECIES OF PARADOXURUS,

INHABITING THE SOUTHERN, CENTRAL, AND NORTHERN  
REGIONS OF NEPAL RESPECTIVELY,

WITH NOTICES OF THE

HABITS AND STRUCTURE OF THE GENUS.

By B. H. HODGSON, Esq.

*H. C. Resident in Népál.**Genus* PARADOXURUS. Cuvier.*Species* P. HIRSUTUS. Milhi.

THIS species is peculiar to the open parts of the Nipalese *Tarāi* and is also found very generally in the British districts on this (the left) side of the Ganges. It is possibly identical with BLAINVILLE'S *Viverra Bondar*, described from a drawing at the India House; and, should it prove so, the trivial name *Bondar* can be retained; if otherwise, the epithet *Hirsutus*, affixed by me in consequence of the extreme length of the animal's hair, may serve to designate the species.

In North *Bihar* as well as in the *Nipalese Tarāi*, this animal is known by the names of *Machabba* and of *Malwa*. It is no more shy of inhabited and cultivated tracts than the common *Mongoose* or *Herpestes Griscus*; and its favourite resorts are the old and abandoned mango groves. In holes of the decayed trunks of the trees it seeks a place of refuge, making such its ordinary dormitory as well as invariable breeding place, and even

procuring its food almost as much amongst the branches as in the grass which is suffered to grow up in these groves after their cultivation has been laid aside. However rapacious its ordinary habits—and those of few of the carnivora are more so—it feeds freely upon the ripe mango in season, as well as upon other ripe fruits : but its more usual food consists of live birds and of the lesser mammals—the former of which it seizes upon the trees as well as on the ground with a more than feline dexterity. It readily kills and devours snakes as well as hares and their young, with mice and rats ; but will not touch frogs or blattæ. One that I had alive escaped from confinement ; and, as soon as the gray of twilight set in, it made its way into the poultry yard, climbing a high wall and killing one goose, two ducks, and seven fowls, in less than an hour !

The Hirsute Paradoxurus is 45 inches in length from the tip of the snout to the end of the tail and about 6-lbs. in weight. The length of the tail, inclusive of the hair projecting beyond its tip, is equal to that of the animal—exclusive, about an inch less. The female is somewhat smaller than the male and rather paler coloured : but the difference is trivial, neither sex nor nonage causing any noticeable diversity in this species. The colour of the animal is a full clear yellow, largely tipped with black, and entirely void of marks or lines upon the body. The entire bridge of the nose, with the upper lip, the whiskers, and broad band thence proceeding over the cheeks, the ears, the chin, and lower jaw, the fore legs wholly, and the hind from the heel downwards, together with the terminal third of the tail, are black or black-brown. The region of the genitals, and a zone encircling the eyes posteriorly, are pure, pale, yellow. The soles of the feet and the snout are brownish fleshy gray : the nude part of the lips, the palate, tongue, and bare portions of the ears and of the genital region, pure fleshy white.

The fur is of two kinds, viz. hair and wool. The former is straight, elastic, not rigid, of great length and free set, not even ordinarily applied

to the body and considerably erigible under excitement. It is two inches and a quarter long, and, for the most part, equally so over the whole body and tail, the face only and limbs being dressed in short adpressed fur. The colour of the hair is, generally, for two-thirds from the root, yellow, and for the terminal third, black ; but here and there a hair wholly black intervenes ; and, sometimes, the hair has a third dusky ring towards the base. The wool is soft, wavily curved in its length, somewhat more than half as long as the hair, and almost entirely of a yellow hue, though close to the skin, it has a dusky colour. This species in its general form exhibits a good deal of the vermiform type ; both the face and body being longer and more attenuated than in either of the subsequent animals. The head is depressed and rather broad ; the face or nose considerably elongated and sharpened : the muzzle largish and vaguely defined : the nares anterior and lateral, opened chiefly to the front, but freely to the sides also, whither they proceed with a strong curve ; being divided both anteaally and superiorly by a deep groove : eyes large, prominent, and possessed of a variable pupil which is, however, for the most part, vertical and linear : Ears well developed, freely exerted from the head and thence having considerable mobility, ovoid, nearly nude, the interior complex, and the fissure at the posterior part of the helix divided and furnished with two salient processes : the body (as already noticed) subvermiform : the neck thick and short : the limbs short and stout, and equally so in both extremities : the feet large, broad, spreading freely, and furnished with full soft fleshy soles : 4 basi-digital, and 2 elongate metatarsal and metacarpal balls : the action and structure plantigrade ; but not typically so, the fur extending in the hind feet  $\frac{3}{8}$ ths of an inch below the os calcis, and the animal using at speed the digitigrade motion with the hind extremities, proceeding by bounds with all four feet at once : the talons  $\frac{3}{4}$ ths vaginate, and as sharp and curved almost as in the Felinæ : the tongue aculeated backwards : the tail equal to the body and head, cylindrico-tapered, thick at the base, not prehensile,

untwisted, and carried sub-horizontally with the terminal part a little raised so as to keep it off the ground.

The females have 4 ventral teats, and produce, I understand, but one brood per annum. The habits of the species render them more active by night than by day—a circumstance clearly provided for by the largeness of their eye with its extremely convex cornea. They sleep rolled up in a ball: when angered, spit like cats; and, like cats and dogs, drink by lapping with the tongue. They are extremely ferocious and unruly when taken mature; but are apparently very capable of being tamed, if caught when young, though the natives of the plains or hills never attempt to subject to discipline their various and high natural endowments. Their cerebral development is much greater than that of the Mongooses; and they have a finer sense of smell, but less acute hearing and diurnal vision. When fighting they grapple with each other like wrestlers, scratching and biting at the same time, but never quitting their hold on the body of the adversary. They are matchless climbers; and derive the extraordinary energy of their double grasp with both hands and feet, whether in scansion or in contests with each other and with their prey, from the high articulation and free lateral motion of their limbs, the great strength and firm insertion in the large humeri of their pectoral muscles, and from the sharpness and curvature of their very mobile sheathed nails,—all points in which they differ remarkably from the Mongooses, and approximate, through the Diluri, to the Bears and Cats. Their rapid action is by digital bounds of the feet,—palmary, of the hands: their walk slow, wholly plantigrade, and deliberate, with the head and tail lowered and the back arched. Their intestines are usually from 4 to 6 times the length of their bodies,  $\frac{2}{10}$ ths of the canal consisting of small gut, and the rest, of the large. They have a short cæcum of about an inch in length, and commonly of the same equable diameter with the large intestine which, as well as the small, is thin, coated, and free from valves, sacks, or any other apparatus calculated to retard the passage

of the food. The stomach is a smooth membranous bagpipe, exhibiting on its outer surface the faintest indication merely of muscular fibre.

The above remarks relative to the organization and habits of the Hirsute *Paradoxurus* are, in the main, equally applicable to the two following species which I shall therefore characterise principally by such differences as they exhibit.

*PARADOXURUS NIPALENSIS*, Mihi. The more peculiar habitat of this species is the central region of *Nepal*, where it is very common : but it is also found in the northern, and occasionally on the confines of the southern, region. It never quits the untamed forest, and very seldom the mountainous country. The intestines of this species are somewhat longer than in the last, or six times the length of the body and head ; and the crowns of its molar teeth are rather flatter—indications of a less carnivorous habit than are supported by the relative manners of the living animals as seen by me in confinement, as well as by the contents of the stomachs of such as were killed in the state of freedom. I kept an individual of this species for four years ; and, though I took no pains to tame it, it exhibited many more signs of docility than I ever witnessed in *P. Hirsutus*. The stomach too of one which I shot in the forests of the central region contained only seeds, leaves, grass, and unhusked rice. The caged animal was fed on boiled-rice and fruits, which it preferred to animal food not of its own killing. When set at liberty it would lie waiting in the grass for sparrows and mynas, springing upon them from the cover like a cat ; and when the sparrows, as frequently happened, ventured into its cage to steal the boiled rice, it would feign sleep, retire into a corner, and dart on them with unerring aim. Birds, thus taken by itself, it preferred to all other food.

This animal was very cleanly, nor did its body usually emit any offensive odour, though when it was irritated, it exhaled a most fetid stench caused by the discharge of a thin yellow fluid from four pores, two of which are placed on either side the anus just within the sphincter. The organs

secreting this liquor are scattered granular specks, from which no ducts are traceable to the pores which emit it.

No similar pores exist in either the preceding species, or in that which will be subsequently described; and yet both of them were ordinarily foetid whilst the present one was not so.\* Doubtless the secretion exists in all, though the pores which carry it off are no more visible to the eye in these species than are the ducts in the other.

The distinctive secreting apparatus of the genus, and which is disposed on either side of the whole length of the male and female organs of generation, has the same form in all three species, and the same secretion. This organ consists of two almond-shaped glands, one of which is laid edge-wise along either side of the membrum virile or of the rima sexualis. These glands are covered on the outer side with fur, but are nude on the inner side; and, the skin being lax and subvalvular, when closed they conceal the sheath of the penis or the lips of the vulva—when opened, exhibit a shallow longitudinal fossa between the glands and those parts—but so shallow that both are laid bare upon a nearly level and wholly nude surface.

Longitudinally the glands are clearly defined by a slight constriction of the skin, especially on their anal extremity, between which and the opening of the anus there is a clear space of an inch, covered with fur like the proximate parts, and forming a simple peroneum, from which, in the male, the testes are suspended in a small hairy scrotum. If you press these glands, with the skin on, they yield a clear thick substance like congealed honey, in small globular particles, issuing from numberless small and similar pores disposed all over the surface of the glands. Pressure, when the skin is removed, causes the protrusion of the same substance, in

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\* This may be explained by the constant state of irritation in which the two former species lived during the short time I had them alive, whilst the latter, from having been taken young and reared in confinement, was ordinarily tranquil.



the form of strings, like vermicelli. The odour of this secretion is strong and musky.

I now proceed with the description of the *Nipalese* species. This species is 48 to 50 inches long from the snout to the tip of the tail; the tail being, as in *Hirsutus*, equal to the body in length when measured with the terminal hair, and about an inch less, if the tail only be admitted. The weight is from 9 to 10lbs., and the whole habit considerably more robust than in *Hirsutus*. In this respect, as in the twisted tail and shorter face of *Nipalensis*, it differs materially from *Hirsutus*, agreeing with the Pongouné or *P. Typus* of CUVIER. Indeed so strictly similar is the conformation of *Nipalensis* to *Typus* that it is unnecessary to say more on that subject; so that we may proceed at once to the fur and colours of our species.\*

The fur is of medial length and of two sorts, pretty much as in the domestic Cat, only longer and thicker. The length of the hair is about  $1\frac{1}{2}$  inches: of the wool, about 1 inch. The former is triannulated from the base with dusky slaty ( $\frac{1}{2}$ ) rufous yellow ( $\frac{1}{4}$ ) and black ( $\frac{1}{4}$ ): the latter or wool wholly slaty. The general effect, in point of colour, is a medial cat gray or brown gray, void of all marks upon the body. Centre of the neck, on the abdominal aspect, chest, belly, and insides of the arms and thighs, pure rufous yellow: tip of tail, paws, ears, lips, chin, a curving line on the cheeks proceeding from the upper lip to the eyes, and a longitudinal mark over the eyes, black or blackish: iris brown: nude skin of the soles, lips, and ears, fleshy brown: palate and tongue, fleshy white: whiskers half white and half black. Those of the lips are very strong, long, and adpressed. There are lesser salient tufts of bristles on the cheeks, above the eyes, and under the chin—attributes common to all the three species.

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\* *Typus*, according to CUVIER, has 6 teats. *Nipalensis* has but four: so also *Hirsutus*. And, as the difference is material, I beg to state my facts have been carefully determined by the examination of several individuals.

The ears in the present species are covered, outside, with hair which also forms a margin round the inner surface. The fissure of the posterior part of the helix is simple, and the processes of the interior are less developed than in *Hirsutus*. Both, as well as the one to be next described, have a small stripe of fur below the os calcis ; and in all the large lax interdigital membrane is covered with hair.

The females have four ventral teats. They are rather less than the males, but otherwise entirely like them : nor does nonage afford any material distinctive signs.

PARADOXURUS LANIGERUS, Mihi. This species is strictly confined to the northern region of *Nepal*, for warding off the cold of which its woolly fleece is peculiarly well adapted. In general conformation and physiognomy it is mediate between the two preceding animals, being less vermiform than *Hirsutus*—less robust than *Nipalensis*. In size it is considerably less than either. It measures only 32 inches from the snout to the tip of the tail, whereof the length of the tail is but 12 inches, or barely more than a third of the entire dimensions. The ears are hairy on the outer side : and the tail is without twist.

The fur consists entirely of wool precisely similar to that of a coarse fleeced sheep. It is about an inch long, and collected into flocs or clumps which incline to a curled appearance. On the legs and face the fur is shorter, closer set, and more like the fur of the congeners of this singularly robed species. The colour is an uniform earthy brown, but paler and fading into yellow, on the belly : the whiskers are white : and the nude parts, fleshy gray. As the *Paradoxuri* generally, and the *Hirsuti* species in particular, bear a resemblance in several respects to the *Viverræ* proper, with which they are ordinarily compared ; the following anatomical details may excite some interest, as well by their novelty, as by the demonstration they afford that striking differences of form and consequently of habits exist between the one group of animals and the other.

The *Muchabba*, as already noticed, is the *Paradoxurus Hirsutus*: the *Catarse* or *Catás*, the *Viverra Rasse vel Indica*; and by these, the popular names, the animals are described in the ensuing memoranda for the greater part of which I am indebted to Dr. CAMPBELL.

The skull of the *Catás* throughout very considerably compressed and elevated in comparison of that of the *Muchabba*, the one bearing in its general form the same resemblance to the cranium of the spaniels as the other does to the skull of the mastiffs. This comparison refers more particularly to the cerebral portion of the heads. In other words, the parietes of the *Catarse* shelve insensibly towards each other, and are surmounted by very large longitudinal and transverse cristæ; whilst those of the *Muchabba* have an ample swell, with ridges far less developed. The articulation of the jaws is somewhat deeper in *Catás* than in *Muchabba*; the coronoid processes considerably larger and more inclined in the latter than in the former. The form of the zygomatic arches and of the orbits, and the proportional length of the frontal and nasal bones, are pretty much the same in both: but the contour of the latter bones is materially different in the one and the other animal. In the *Muchabba* the frontal and facial line, from the commencement of the longitudinal crista to the end of the nose, is straight in its length; whilst, in the *Catarse*, it is arched: and, if these parts be regarded in reference to their *transverse* outline, in the *Catarse* they present a strong and perfect convexity throughout—in the *Muchabba*, a level, depressed along the mesial attachment into a groove which occupies the whole extent of the nasal bones and the anterior half of the os frontis. The receptacles of the auditory apparatus are three times as large in the *Catarse* as in the *Muchabba*: but those containing the olfactory organs are somewhat larger, though by no means compensably so, in the latter than in the former skull. The infra-orbital foramen is twice as great in the *Muchabba* as in the *Catarse*, corresponding to the superior size of the whiskers in that animal. The teeth have in both skulls the same positions, forms,

and numbers: but the canines are sharper and rather more curved, and the processes of the molars are much more acute and longer too, in the *Catarse* than in the *Muchabba*. The skull of the *Muchabba* measures  $4\frac{1}{2}$  inches in length, 2 and  $\frac{1}{4}$  in width, and  $1\frac{1}{8}$ th in height: That of the *Catarse*  $4\frac{1}{8}$  in length,  $1\frac{3}{4}$  in width, and  $1\frac{5}{8}$  in height. In proceeding with this comparison the osteology of the *Muchabba* will be chiefly detailed, the differences, merely, presented by that of the *Catarse* being noticed as they occur.

The cervical vertebræ are seven, and measure together 4 inches. The lateral processes or alæ of the atlas are broad and strong, as is the spine or crest of the vertebra dentata.

The six anterior vertebræ only of the neck are pierced in the transverse processes by the canal of the vertebral arteries; and, with the exception of the two first and the last, all have strong transverse processes resembling those of the lumbar ones. To this may be attributed the strength and thickness of neck so prominent in the animal when alive and so essential to his predatory habits. The vertebral arteries enter the spinal canal in the articulating cup of the atlas, having a tortuous course through its body, and they penetrate the condyles of the occipital bone immediately after entering the skull. The seventh cervical has all the characters of the dorsal vertebræ except the depression for the articulation of the rib. In the *Catarse* the cervical vertebræ are seven as in the *Muchabba*; but they are so much longer in the former animal as to measure one-third more, or six inches. The crest too of the vertebra dentata is higher and arched, giving that graceful bend of the neck so noticeable in the living *Catarse*.

Dorsal vertebræ 13, smaller in their bodies and transverse processes than the cervical ones. The 10 anterior ones have spinous processes pointing backwards: the three posterior ones have no transverse processes for the articulation of the ribs, which are merely articulated with a small depression on the anterior end of the body of the vertebræ. The lumbar

vertebræ are seven in number and large: the transverse processes of all pointing forwards, those of the two first and of the last one, smaller than the others. Sacral vertebræ three, united by ossification of the lateral processes—passages being left opposite the intervertebral spaces for the transmission of the sacral nerves. Caudal vertebræ 28, the first four having a remains of the spinal canal. The number of vertebræ here exceeds that of the *Catarse* by 4. The pelvis is shorter and broader in the *Muchabba* than the *Catarse*, the symphysis pubis being in the latter  $1\frac{1}{8}$  inch long, and in the former, only  $\frac{3}{4}$  inch. In the *Catarse* the acetabulum is much smaller in circumference and not so deep: but the groove in the anterior margin for the lodging of the round ligament is the same in both animals. The sternum is composed of eight distinct bony pieces of a cylindrical shape: the posterior one furnished with heart-shaped cartilage  $\frac{3}{4}$  of an inch long, projecting beyond the attachment of the last pair of true ribs. The ribs are 13 pair, 9 true or articulated with the sternum by intermediate cartilage, and four false. The scapulæ present nothing remarkable to assist in elucidating the muscular powers of the animal, save the largeness of the spine and the extent and shallowness of the glenoid cavity—the former indicating the strength of the scapular muscles, and the latter, a great latitude of motion in the humerus. The glenoid cavity is oval-shaped and twice the extent of that in the scapula of the *Catarse*. And here we have the first indication of a prominent difference in the motive organs of the one animal from those of the other.

The humerus is  $3\frac{3}{8}$  inches long, strong in its shaft, and bearing prominently all the marks of a bone subjected to vigorous and varied muscular power. Its head is large and represents a small segment of a large circle. It appears twisted towards its distad extremity, where it dilates into two large condyles for the origin of the strong muscles of the hand and fingers; and the ridge for the insertion of the great pectoral muscles is strongly marked. Contrasted with the humerus of the *Catarse* it helps much to

illustrate the structure required for a plantigrade and climbing action, as compared with a digitigrade one.

The animals are as nearly as possible of an equal mean height: but the length of the corresponding bones is far from equal. The *Catarse* moves solely on his fingers by which means the length of his metacarpal bones and of his wrist are added to his height. The *Muchabba* walks entirely on his hands and wrist, being thus deprived of his carpus and metacarpus as a part of his stature from the ground. But he is compensated for this by an increased length of humerus and forearm nearly amounting to the length of the metacarpus which is added to these bones in composing the height of the *Catarse*. The centre metacarpal bone of the *Catarse* is one inch long: His humerus half an inch shorter than that of the *Muchabba*, and his radius (the true forearm)  $\frac{3}{8}$  of an inch shorter than that of the other animal. The humerus of the plantigrade animal is strongly marked with a large ridge for the insertion of a pectoral muscle which rises from the whole length of the sternum; is furnished with broad condyles for the origin of the muscles of the hand and fingers; and has an extensive surface for articulation with the scapula. All these signs indicate free action of the arm on the trunk, with extensive motion of the hand and wrist. The humerus of the digitigrade animal, compared with the above, is weak and short; is not so prominently marked with ridges; its condyles scarce project beyond the articulating surface or trachlea; and it shews a limited surface for articulation with the scapula. These marks attest a more limited power of arm and hand, and a less free motion of the extremity on the trunk. The radius in the *Muchabba* is much stronger and  $\frac{3}{8}$  of an inch longer than in the *Catarse*: its articulating surface which enters into the composition of the elbow joint, is twice as large as that of the other: its rotatory motion on the ulna is much more free and extensive, enabling the animal to bring the hand from the state of pronation freely round to that of semi-supination;

and its distad extremity is dilated into a large articulating surface for the attachment of the wrist. The ulna, as is usual where the radius is capable of rotation and forms the chief articulation with the carpus, becomes gradually smaller towards its end where it terminates in a round point. In both animals it enters but sparingly into the wrist joint, being articulated with one carpal bone only. The bones of the carpus are seven : those of the tarsus are seven also : the metacarpal and metatarsal ones are five,\* corresponding to the number of fingers. The latter bones, as well as those of the digits, are all nearly of equal length. The articulation of the metacarpal and metatarsal bones with the carpus and tarsus is free, affording much power of motion on one another. These bones admit also of flexion and extension on the wrist and ankle ; instead of forming a compact arch, as in the *Catarse*, where they are raised from the ground. The five digits of the hands and feet are all produced to the front, the thumbs not being retracted as in the *Catarse* ; and they are armed with feline talons. Each digit has three phalanges endowed with the most extensive motion. To all these peculiarities of structure it is owing that the *Muchabba* is enabled not only to climb trees with ease and rapidity, but in its own defence as for purposes of aggression to grasp an object with considerable strength and with the feet as well as the hands. It cannot of course bend the digits on the palms, but with one hand opposed to the other and the free rotation of the radius on the ulna the *Muchabba* clasps the branch of a tree or the body of its antagonist when fighting with the greatest ease, and apparently with much force. The *Muchabba* in these respects differs much from the *Catarse*, whose efficient fingers are, besides, only four, with a small fifth, one behind and before, but of little use from

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\* There are also two small sesamoid bones placed over the articulation of each metacarpal and metatarsal with the first phalanx, to serve as fulcra for the digits.

their elevation and imperfect development. Nor are its talons either so acute, so curved, or so mobile, as those of the *Muchabba*.

The bones of the fore arm and leg are separate in both : and the wrists and ankles of both contain the same number of bones : so also do the digits :\* but in the *Catarse* there are only 4\* metacarpal and metatarsal bones, instead of 5 ; and the bones of the fore arm and of the leg are more slender and have smaller articulating surfaces in *Catarse* than in *Muchabba*.

From the foregoing remarks it is apparent that the whole structure of the limbs down to the talons is in the *Muchabba* suited to scansion, in the *Catarse* to running. The few observations which follow will shew that these osteological differences are accompanied by others in the structure of the soft parts. The urinary and generative organs with their appendages, although in one point essential for classification bearing a resemblance, are widely different in each. Placed on the sheath of the penis anterior to the scrotum there is a secreting organ : but, while in the *Catarse* it consists of a hairy lump, having the size and nearly the shape of a walnut, with a deep cleft in its centre terminating in a cavity which is again subdivided transversely into two hairy depressions, in the *Muchabba* it is simply a longitudinal naked secreting space wholly exposed to view.† The penis of the former is very small, bony, and pointing to the ground : that of the latter large, without bone, pointing anteriorly, and covered by a strong membrane thickly studded with horny points. The prostate gland of the

\* In respect to the metacarpal, metatarsal and digital bones of *Catarse*, it would perhaps be more correct to say that there are five bones to the former, and only two to the inner digits ; removing the deficiency from the one part to the other.

† Dissection proves the secreting organ to consist of two bodies in both animals. But in *Catarse* the two parts of it are closely and firmly knit together over the penis, whilst in *Muchabba* they are quite separated, and have the penis lying freely between them. The secretion is more musky in *Catarse* than in *Muchabba*.



one is small, two-lobed, and has the urethra passing through its centre: That of the other, as large as man's, and with the third lobe largely developed, lies high in the pelvis, and has the urethra passing through its surface nearest the rectum; the mass of the organ being between the pubes and urethra. The anus in both animals is without palpable secreting glands, ducts, or pores.

The small salivary glands and the general nature of the chylopoetic viscera in both proclaim carnivorous habits, as contrasted with the same parts in herbivorous animals. Throughout the stomach and intestinal canal of the *Muchabba*, there is nothing found to retard the speedy passage of the food. The œsophagus enters the stomach close to the left extremity leaving no cul de sac. The intestines are thin coated: the small cæcum undilated at its distad extremity: and, although the intestine is wider from that to the anus than above it, there is no trace of sacculi in it, and its course is nearly straight to the vent. The whole intestines in both animals are usually about four times the length of the body and of small calibre. But the smaller ones of the *Catarse* are thicker in their coats: its cæcum is longer, and dilated at its further extremity; and there are three valvulæ conniventes found in its large gut. Its stomach also is thicker and less purely membranous. These circumstances would lead to the idea of this animal being less blood-thirsty than the *Muchabba*.

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## VIII.

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### S K E T C H OF AN UNDESCRIBED H O O D E D S E R P E N T, WITH FANGS AND MAXILLAR TEETH.

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BY. DR. TH. CANTOR.

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HAMADRYAS, *Nov. Gen.*

*Caput latum, subovatum, deplanatum, rostro brevi, obtuso. Canthus frontalis obsoletus. Buccæ tumidæ. Oculi magni, prominentes, pupilla rotunda. Nares late apertæ, laterales, duorum scutellorum in confinio. Scuta rostralia frontalibus minora; scuta supraorbitalia scuti verticis ejusdem magnitudinis, scutella præorbitalia duo, postorbitalia tria; scuta occipitalia maxima, sex magnis scutis circumdata. Dentes veneni antici, pone quos pauci dentes maxillares. Gula squamosa. Collum dilatabilis. Truncus teres, abdomine rotundato, squamis lævibus, per series obliquas dispositis, imbricatim tectus. Cauda brevis, scutis & scutellis tecta.*

HAMADRYAS HANNAH.

*Superne olivaceo-viridis, striis sagittalibus nigris cincta; abdomine glauco, nigro-marmorato; cauda fere  $\frac{1}{2}$ .*

The shape of the head is very like that of the *Naja tripudians*, MERREM, the Cobra Capello, covered above with 15 larger shields in 5 ranges, the first of which containing 2 scuta rostralia, the second 2 frontalia, the third 2 supra-orbitalia and the scutum verticis, the fourth 2 occipitalia, surrounded by the fifth range, consisting of 2 postoccipital and a temporal shield on each side. These scuta as well as the others, covering the temples and lips,

are of a drab color, edged with black. The integuments of the upper part of the head as well those of the side and of the chin, are represented in the accompanying drawings. The muzzle obtuse, rounded, with a wide semi-circular opening for the tongue, which organ is black, thick, bifurcate. The nostrils lateral, wide, between 2 shields. The eyes prominent, large, brilliant; golden iris, round pupil, surrounded by 3 postorbital, 2 præorbital and 2 labial (the 4th and 5th from angulus oris) shields. The upper lips covered with 7, the under lips with 8 shields. The mouth large; in the upper jaw, a little longer, than the lower, 2 rows of palatal, sharp, reflex, distant teeth: two fangs on each side, covered as usual with a duplicature of the palatal membrane, behind those a few (3-5) maxillar teeth. Two rows of sharp, reflex teeth in the lower jaw. The neck dilatile, <sup>(1)</sup> though in a less degree, than that of the *Naja tripudians*, so that the hood or disque of this Serpent, is comparatively more oval, narrower, but thicker, than the hood of the latter. The back of the hood is covered with oval smooth scales of an olive green color, those which cover the black skin with a black margin, those covering the white skin of a lighter colour and without black edges. The anterior part of the hood is formed by the first 16 to 18 abdominal scuta, of a reddish yellow color, and the two lowest rows of scales, between which appear two black spots on each side, formed by the interstitial black skin. The trunk thick, cylindrical, tapering towards the tail, covered with 21 oblique ranges of smooth, imbricate scales of 3 different shapes (Pl. XII. Fig. E.) Their color is olive green; the interstitial skin is partly black, partly white, disposed in such a manner, that it forms a number of bands, converging in the direction of the head; the black prevalent towards the tail, near which the colors become much more bright, which is in general not the case with Serpents. The broad abdominal

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(<sup>1</sup>) The power of dilating the skin of the neck and thus forming a hood or disque is a characteristic of the genus *Naja*, LAURENTI, of which two distinct species are known, viz. the *Naja tripudians*, with a number of varieties, most of which are mentioned and figured by RUSSELL, and the *Naja haje*, Coluber haje, Linné, L'Aspie, the Aspis of the Classics, represented by GEOFFROY ST. HILAIRE, and SAVIGNY, in "Description de l'Egypte."

scuta are bluish grey, interspersed with black as they approach the tail. The tail cylindrical, gradually tapering into a sharp point, covered above with hexagonal, yellowish green scales, marked with pitch black, so that its general appearance is black, divided by yellow rings, and interspersed with spots of the same color. From the broad semicircular plate, covering the anus, proceeds a number of blackish blue, somewhat chequered, scuta, after which commence by pairs the subcaudal scutella.

How little confidence can be put in counting the abdominal scuta and subcaudal scutella, using as a guide their number, which varies nearly in each single individual of the same species, is a remark made long ago by several Naturalists. The following Tables shew the difference in this respect as well as the respective dimensions of four specimens, which have come under my inspection.

	1 (*)	2.	3.	4.
Scuta abdominalia,.....	245	215	219	235
Scuta subcaudalia, .....	13	10	11	32
Scutella subcaudalia, .....	68	79	71	63

	1.	2.	3.	4.
	Feet. Inch.	Feet. Inch.	Feet. Inch.	Feet. Inch.
Length of the head,.....	0 2.0	0 2.3	0 2.1	0 2.5
„ of the trunk, ....	6 6.3	7 0.0	6 2.3	8 0.2
„ of the tail, .....	1 6.0	1 9.2	1 7.4	1 7.0
Total length, ....	8 2.3	8 11.5	7 11.8	9 9.7

	1.	2.	3.	4.
Circumference of the neck,	0 3.6	0 4.7	0 3.9	0 5.2
Greatest circumference of } the trunk, .....	0 6.3	0 8.2	0 6.8	0 8.4

(\*) No. 1 is the specimen here described.

The natives say, that individuals are found upwards of twelve feet in length; at all events this Serpent for a venomous one is remarkable for its size, which, even if attained by any of the others hitherto described, is certainly not surpassed. In general these reptiles are of a comparative small size, and perhaps the greatest ever described is a species of DAUDIN's genus *Bungarus*, which attains according to CUVIER seven or eight feet (*Règne Animal* II. p. 96). Another venomous Serpent, generally reckoned amongst the greatest, is *Vipera lanceolata*, DAUDIN, *Trigonocephalus lanceolatus*, OPPEL, the size of which is six to seven feet; that one has ever been seen upwards of nine feet, is considered very doubtful (*Diction des sc. nat.* LV. p. 302.) Three of the above-mentioned specimens were caught in the Sunderbuns, the fourth in the jungle not far from Calcutta. According to the natives, this Serpent chiefly feeds upon other Serpents; two specimens in my possession were regularly fed by giving them a living Serpent, no matter whether venomous or not, every fortnight. (<sup>s</sup>) As soon as this food is brought near, the Serpent begins to hiss loudly, and expanding the hood raises about two or three feet, and darts upon its prey just in the same way, as the *Naja tripudians* does. Dr. RUSSELL says, (I. p. 85), he could never induce the venomous Snakes to feed spontaneously. I have had various opportunities of verifying this with the *Naja tripudians*, *Vipera elegans*, DAUDIN, *Bungarus annularis* DAUDIN. The *Hamadryas* only makes an exception. This, however, is not the case with those venomous Serpents armed with fangs behind the maxillar teeth, (*à crochets postérieurs*), which I have had opportunity to observe, viz. *Cerberus Grantii* mihi and *Potamophis Lushingtonii* mihi, both of which readily enough swallow their food.

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(<sup>s</sup>) The Snake-catchers before they feed Serpents, kept in cages, are accustomed to give them a quantity of water, which is readily swallowed. As I have witnessed this fact very often, I cannot help remarking how perfectly wrong the physiologists are, who state, that Ophidians never drink. On the contrary, these animals both drink and moisten their tongues, which, with the Serpents whose tongues are not situated immediately in the cavity of the mouth, become two quite different acts.

The fresh poison of the *Hamadryas* is a pellucid fluid, in consistence like a solution of gum-arabic in water. It reddens slightly litmus paper, which is also the case with the fresh poison of the *Naja tripudians*, *Vipera elegans*, *Bungarus annularis*, and *Bungarus cæruleus*; when kept for some time it acts much stronger upon litmus, (the color of which is easily restored by the application of carbonate of magnesia,) but after it is kept, it looses a great deal of its deleterious effects. Reserving the experiments made with the poison of this Serpent upon living animals, I shall merely state here, that the poison seems to act less quickly than that of the *Vipera elegans* and the *Naja tripudians*; but it should be remarked, that the experiments were made during the cold season. This specimen, which was brought me in the beginning of November last, changed its skin in the end of December, a process, which I have reason to believe takes place in this as well as in the other Ophidians of this country several times during the year.

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In consequence of the strong resemblance between the *Hamadryas* and the *Naja*, I should consider them as neighbouring genera, and I even at first thought I could refer this Serpent under the genus *Naja*. Circumstances however prevented me till latterly from being able to examine specimens, whose fangs were untouched (those of the former having been drawn by the Snake-catchers, who are much more afraid of this, than of the Cobra,) when I discovered the peculiarity of the maxillar teeth behind the fangs, which is found in the *Bungari* and *Hydri*, but never in the *Najas*. This material anatomical difference, in addition to the others existing in the external appearance, occasioned me to form a new genus. (\*)—*Hamadryas Hannah* differs from *Naja tripudians*:

1. By its having maxillar teeth behind the fangs.
2. By the spina on the os occipitale inferius, which, like that of the *Vipera elegans*, is of a remarkable size and much more developed, than the same of the *Naja*.

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(\*) *Hamadryas H.* is said to inhabit hollow trees, and is frequently observed between their branches.

3. By the integuments of the head.
4. By the integuments covering the abdominal surface of the tail.
5. By its color.
6. By its food, chiefly consisting of other Serpents, which is not known to be the case with any of the other Ophidians, which shew themselves rather inclined to evite, than to attack each other.
7. By its size.

I have often heard asserted, that "*Cobras*" (which name is naturally enough attributed to every hooded Serpent,) have been met with of an enormous size, but I strongly doubt their belonging to the *Najas*, which scarcely exceed 5 to 6 feet in length. Some time before I discovered the *Hamadryas*, I was favoured by J. W. GRANT, Esq. with an interesting description of a gigantic hooded Serpent, he had observed at Beaulah, and which he remarked was no Cobra, adding, he was of opinion, that besides Cobras there are other hooded Serpents in this country. By inspection Mr. GRANT denied the *Hamadryas* to be identical with the above-mentioned, from which it differed in size and color.

The native name of *Hamadryas Hannah* is '*Sunkr-Choar*'; another hooded Serpent, called '*Mony-Choar*,' is said to attain a much larger size than the former.

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#### EXPLANATION OF THE PLATES.

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##### PLATE X.

- A. Head of the Serpent preparing to attack, expanding the hood.
- B. Front view of the completely expanded hood.

##### PLATE XI.

- A. The venomous apparatus and the surrounding parts.

##### MUSCLES.

1. Vertebro-mandibularis.
2. Cervico-angularis with
- 2' its cutaneous portion.

3. Digastricus with
- 3' its cutaneous portion.
4. Temporalis posterior with
- 4' its maxillar portion.
5. Temporalis medius.
6. Temporalis anterior with
- 6' its maxillar portion.
7. The sac surrounding the venomous gland.
8. The excretorian duct.
9. The duplicature of the palatal membrane, covering the fangs.
10. Submaxillar salivarian gland.
11. Submandibular salivarian gland.
12. Tendo articulo-maxillaris, spreading carneous fibres over the sac.
- B. The venomous gland and its surrounding muscles loosened and bent over to shew the subjacent muscles.
  1. Vertebro-mandibularis.
  2. Cervico-angularis.
  3. Digastricus.
  4. Temporalis posterior.
  5. ——— medius.
  6. ——— anterior.
  7. The venomous gland.
  8. Pterygoideus externus.
- C. Lateral view of the skull.
- D. 1. External appearance of the venomous gland.
2. The gland longitudinally divided, by which the cells and their little ducts proceeding into the common excretorian duct, are laid open.

PLATE XII.

- A. The integuments covering the head and part of the neck.
- B. The integuments of the lips, chin and throat.
- C. Outline of the head of the specimen No. 4, in the text.
- D. Outline of the head of a *Naja tripudians*, about 4 feet in length.
- E. Scales.
  - 1 of the neck.
  - 2 and 3 of the trunk.
  - 4 of the tail.
- F. Outline of the integuments covering the abdominal surface of the tail.



## IX.

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DESCRIPTION  
OF  
TWO GENERA OF THE FAMILY OF  
HAMAMELIDEÆ,  
TWO SPECIES OF PODOSTEMON  
AND  
ONE SPECIES OF KAULFUSSIA.

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*Ast.-Surgeon, Madras Establishment.*

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1. BUCKLANDIA.

R. Brown in Wall. Catal. No. 7414, (sine caractere).

Syst. Linnean DODECANDRIA DIGYNIA.

Char. gen. *Flores* polygami, capitati, nudi. *Antheræ* valvâ dehiscences.

Ord. Nat. HAMAMELIDEÆ. R. Brown loc. citat.

Char. gen. *Flores* capitati: *capitula* 8-flora. *Antheræ* valvâ dehiscences. *Capsula* bilocularis, 12-sperma: *semina* bina infima cujusque loculi perfecta, hinc alata.

*Arbor* magna, facie *Populi* cujusdam. *Ramuli* abrupte terminati, apice gemmiferi. *Squamæ* vel tegmenta gemmarum binæ oppositæ! *Folia* alterna exstipulata. *Pedunculi* terminales.

BUCKLANDIA POPULNEA. R. Brown loc. cit. Ejusd. Vermischte Schriften V. p. 374.

Hab. in collibus Khasiyanis a *Chirra Punji*, ubi arbuscula, usque ad *Sarrarim*, ubi arbor magna.

Florentem fructiferamque legimus mense Octobris, 1835.

*Arbor* in locis idoneis ex auctoritate WALLICHII 60—70-pedalis, cortice suberoso brunneo, coronâ irregulari. *Lignum* compactum, grave, e vasis parvis plurimis fibrisque minutis formatum. Medullæ carnosæ densiusculæ cellulæ punctatæ. *Radii medullares* plurimæ angustissimæ. *Zonæ* concentricæ inconspicuæ. *Vasa spiralia* circa medullam disposita, interdum composita. *Vasa corporis* lignei annulata punctataque? *Fibræ* punctatæ, punctis istis coniferarum similibus. *Ramuli* flexuosi, glabri, lenticellati, articulati, articulis tumidiusculis, hinc cicatrice folii lapsi notatis; novelli læviusculi, abrupte et oblique terminati, foliaque vel viridia vel rubro-colorata et glaucescunt cito evanidâ tecta. *Gemmæ* semper terminales, foliiferæ vel folio-floriferæ, bisquamatæ! *Squamæ* oppositæ, foliaceæ, ovales, coriaceæ, integerrimæ, marginibus cartilagineis arcte approximatis. *Foliiferæ* (vel *ramuliferæ*) diu persistentes clausæque, planiusculæ, faciebus interioribus basi tantum exceptâ arcte cohærentibus, sæpius (an semper?) foventes ramulos tres minutos, quorum quisque hinc apice gerens folium conduplicatum, hispidissimum pilis ferrugineis, crebre septatis acutis, summoque apice gemmarum squamas pariter hispidissimas; longitudinaliter et inconspicue venosæ sunt, externe et præsertim supra medium stomatosæ, cuticulâ interiore quasi fibrosâ et hinc illinc stomatibus incompletis rarius donatâ. *Folii-floriferæ* oblongæ, ventricosæ, sub-inflatæ, ad anthesin secus marginem alterum spathæ in modum fissæ, cito bivalves, demum nec tarde deciduæ, membranaceo-coriaceæ, præcedentibus minus foliæcæ, extus brunnescentes, intus albidæ, utrinque (an semper?) stomatibus orbatæ; fovent ramulos ejusdem fere formæ ac in istis, apice floriferos et pilis brevioribus hispidos, folio ramuli exterioris tantum complete evoluti. *Folia* alterna exstipulata, ramulos semper

oblique terminantia, longiuscule petiolata, late cordato-ovata, interdum fere deltoidea, longe cuspidato-acuminata, sæpissime indivisa, aliquando bitriloba, coriacea, integerrima, subrepanda, margine cartilagineo, supra læte viridia lucidaque, subtus subglaucescentia, novella utrinque, sed præsertim subtus (vel in gemmis extus) ad venas et ad margines pilis antea memoratis cito deciduis hispidissima. *Venatio*: vena primaria (costa auctorum) ad apicem recte excurrit, secundariis duabus infimis utrinque basi folii approximatis, ideoque folium basi subquinquevenium, omnibus sed his præsertim arcuatis et mediantibus venis tertiariis connexis; venulæ intramarginales inconspicuæ. Pagina cæterum areolatim reticulata est. Cuticula infera tantum stomatosa, utraque c cellulis varie angulatis parvis conflata. Stomata ovalia, parva.\* *Petoli* longitudine valde variabiles, interdum 4-unciales, sæpius 2-unciales, utrinque incrassati transverseque rugosi, supra a medio usque ad apicem sulcati. Flores polygami, hermaphroditi nempe et fœminei in arboribus distinctis, capitati; octo in singulo capitulo verticillis binis alternantibus dispositi. *Capitula* subterna, in pedunculis solitaria, globosa, viridescencia, interstitiis florum præsertim fœmineorum dense pubescenti-pilosis. *Pedunculi* teretes, longitudine varii, semiunciales, vel unciales fere. *Calyx* semisuperus, subcampanulatus, ore truncato carnosio repando sub-5-lobo, lobis medio sulcatis, sinibus alternis profundioribus; fructûs induratus,  $\frac{1}{4}$ -superus, cæterum parum mutatus. *Petala* perigyna, floris hermaphroditi numero varia, sinibus profundioribus oris calycini opposita, lineari-spathulata, carnosae, integra, decidua, per æstivationem arcuatim incurva, sæpe in stamina incomplete mutata; floris fœminei subquaterna, rudimentaria, subulata, cito sphacelata decidaque. *Stamina* 10-14 (an unquam plura?) perigyna, diutius persistentia; floris fœminei nulla, ne rudimentaria quidem. *Filamenta* subulata, subæqualia,

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\* These bodies consist of a central opaque areola, generally furrowed along the middle, surrounded by a transparent ring. But in other states the central areola is neither opaque nor furrowed, and appears under an indifferent lens of the focal distance of  $\frac{1}{20}$  of an inch to be closed by a membrane.

per æstivationem varie flexa, post anthesin versus apicem sphacclata (an semper?); horum petalis alternantia semper solitaria. *Antheræ* oblongæ, prope basin adfixæ, per anthesin sæpe tortæ, biloculares, valvatim dehiscentes, loculorum sulco connectivo approximato; valvulæ valde inæquales, interna angustissima, externa lata longitudinaliter et extrorsum revoluta, ambæ persistentes, nudæ, cito coriaccæ, demum rectæ et faciebus externis mutuo applicitæ. *Connectivum* lineare angustissimum, apice ultra loculos in apiculum brevem productum. *Pollen* ovale, læve, hinc centraliter et longitudinaliter sulcatum. *Ovarium* (in flore fœmineo majus) semi-inferum, ovato-oblongum, biloculare, loculis anticis posticisque ☉, 12-sporum, septi dimidio superiore tantum placentigero, parte liberâ primum pilis brevibus albis pubescens, demum glabratum. *Styli* duo, subulati, glabri, revoluti. *Stigmata* plana, facies internas stylorum a medio circiter supra occupantia. *Ovula* cuique loculo 6, biseriatim collateralia, pendula (duobus infimis appensis) difformia; 4 superiora semper abortientia. Duo summa minima, intima, ovali-oblonga, supra ad foraminis situm quasi truncata, tegumentis nucleoque vix distinctis. Duo intermedia majora, sursum paullo, deorsum valde elongata, ambitu ovato-lanceolata, mutuâ pressione ad faciem interiorem angulata, extus convexa, foramine supero distincto hiantes, tegumentis nucleoque manifestioribus. Duo infima et extima semper fertilia, fundum loculi implentia, convexo-trigona, facie nempe interiore angulatâ, exteriori convexâ. Tegumenta bina, distincta, utraque celluloso-membranacea; *exterior* ratione interioris maximum, sursum in alam loculi parietibus externis applicitam productum; foramen superum, rimæforme, transversum, alæ basin versus situm, ideoque quam maxime inæquilaterale; *raphe* parum elevata, hinc ad latus internum anguli seminis intimi currens; *chalaza* maculâ brunneâ notata. *Interior* lageniforme, nucleum ovatum discretum continens, colli ore denticulato, foramen longitudine subæquante vel paullo superante. *Fructus* multiplex, subglobosus, induratus, interstitiis calycum rugosis. *Capsula*  $\frac{3}{4}$ -supera, demum omnino libera, calyce indurato inferne cincta, ovata, stylis stigmatibusque induratis rectiusculis coronata,

glabra, ecorticata, bilocularis. *Endocarpium* osseum fragile nitidum. *Septum* bilamellatum. *Dehiscentia* loculicida, incomplete bivalvis, valvis medio septiferis, demum bipartitis, sæpe stylis longitudinaliter bipartitis apiculatis. *Semina* cujusque loculi 6, situ ovulorum. Quatuor superiora abortiva solida, extus ossea; duo summa sursum truncata, deorsum producta, extrorsum curvata; duo situ et magnitudine intermedia sursum paullo, deorsum longe producta et in sinibus alarum seminum inferiorum quasi nidulantia, intus angulata, extus convexa; duo infima fertilia formâ auriculam humanam referentia, convexo-trigona. *Tegumenta* bina leviter accreta; *exterius* celluloso-membranaceum, subcoriaceum, e cellulis sinuosis conflatum, secus marginem exteriorem ab ipsa basi fere sursum productum in alam oblongam bilamellatum, lamellâ exteriori maximâ alæ formam dante, interiore oblique truncatâ. *Foramen* immutatum! *Interius* cellulosum, brunnescens, albumini leviter adnatum; collo brunneo-sphacelato, ore dilatato dentato ultra rimam foramen nunc exsertum. *Albumen* parcum, album, carnosum. *Embryo* inversus, albus, longitudine et latitudine fere albuminis, axilis, directione obliquus. *Radicula* conica, subulata, cotyledonibus duplo brevior, apice collum membranæ interioris subintrante. *Cotyledones* planæ, carnosæ, ovals, inconspicue venosæ, faciebusseminis parallelæ. *Plumula* inconspicua.\*

## 2. SEDGWICKIA. WALL. ET GRIFF.

Ord. Nat. *Hamamelidæ*.

Character gener. Flores capitati, numero indefiniti. Capsula bilocularis. Semina indefinita, unico infimo cujusque loculi perfecto, marginato-alato.

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\* Seeds of this plant which were sown in the Honorable Company's Botanic Garden at Calcutta, on the 2d November 1835, commenced germinating on the 18th of the same month. Of these I have examined two in an early and dried state. The integuments were ruptured irregularly at their apices and the wing had totally disappeared. The inner one had become quite distinct, the albumen had disappeared. The radicle had reached a considerable length. The cotyledons were for the greater part enclosed within the integuments, but had enlarged and assumed a greenish tint. No plumula had been developed.

*Arbor* excelsa Cerasum quodammodo habitu referens, aromatica. *Gemmæ* axillares terminalesque imbricatim squamatae. *Folia* alterna stipulata. *Pedunculi* axillares.—Locus in systemate Linneano incertus.

Jam anno 1832 genus Bucklandiæ Hamamelidearum Indicarum Geologo summo Oxoniensi dicavit Robertus Brown; alterum nunc genus novissimum ejusdem ordinis consecramus viro reverendo Adamo Sedgwickio, Geologiæ apud Cantabrigienses professori pariter illustri.

SEDGWICKIA CERASIFOLIA. Wall. et Griff.

Hab. in regione Assamiæ superioris Muttack dicta, inter Debrookh et Rangagurrah, in gradu longitudinis orientalis 95, latitudinis borealis 27. Fructiferam invenimus mense Februarii, 1836. Humida amat.

*Arbor* 50—60-pedalis, satis formosa. *Truncus* sæpe basin prope divisus; cortice læviusculo cinereo-albido, gummi-resinam piperaceo-aromaticam parcam continente vel effæta. *Corona* oblonga apicem versus præsertim fructifera, ibidemque ut plurimum foliis orbata. *Lignum* grave compactum ut in Bucklandia. *Fibræ*, æque præsertim circa vasa dispositæ, punctatæ, punctis persimilibus istis Coniferarum, 1-seriatis. *Ramuli* teretiusculi, griseo-brunnei, hinc illinc lenticellis exasperati, fructiferi abbreviate et apicem versus confertim foliosi. *Gemmæ foliiferae* conspicuæ axillares, præsertim in ramis sterilibus, et terminales, cylindracco-subulatæ: squamæ arcte imbricatæ mucronatæ, sursum majores; inferiores rotundatæ, scariosæ, coriaceæ, rubro-brunneo plus minus tinctæ, glabræ vel leviter pubescentes; superiores oblongæ ferrugineo-pubescentes, sursum magis magisque in folia abeuntes. *Pubescentia* simplex. *Folia* alterna, petiolata, ovato-oblonga, acuminata, serrata, (serraturis glandulosis) subcoriacea, supra lutescenti-viridia, subtus pallidiora, matura supra glabra, subtus subpubescentia, axillis venarum secundarum villosis, contusa (haud secus ac cæteræ arboris partes) odorem aromaticum piperaceum effundentia; vernatione involuto-imbricata. *Venatio*: venæ infra prominulæ; secundariæ alternantes, supra medium arcuatæ et ope tertiariarum irregulariter nexæ; cæterum venulæ reticulatim anastomosantes, venulis additoriis secundariis sæpe interjectis.

*Cuticula* utraque e cellulis sinuosis conflata; superior stomatibus expers. *Stomata* minuta, ovata, disco opaco quasi glanduloso, areolæ circumambientis parietibus rectis. *Petoli* basi inarticulati, utrinque paullo incrassati, supra canaliculati, apice utrinque glandulosi. *Stipulæ* lineares, angustæ, obtusæ, secus marginem exteriorem glandulosæ, vel caducæ sunt, vel subinduratæ persistunt, et tunc elongatione petioli supra basin hujus paullo elevantur. *Inflorescentia* axillaris, sed ob approximationem foliorum terminalis sæpe videtur. *Flores* desiderantur. *Fructus* indefinite multiplex, globosus, magnitudine cerasi majoris, induratus, rugoso-verrucosus, stylis stigmatibusque persistentibus induratis subrevolutis quasi echinatus, pube brevissimâ ferrugineâ simplici velutinus. *Pedunculi* sesquiunciales, adscendentes, insertione articulati, læviusculi, brunneo-cinerei. *Calyx* fructûs  $\frac{3}{4}$ -superus induratus, truncatus, ore varie lobato, lobis angulatis medio sæpe conicis, minutissime ferrugineo-velutinis, demum liber. *Stamina* (an perfecta?) hinc illinc diu persistentia, perigyna, subsessilia. *Connectivum* angustum. *Antheræ* adnatæ, oblongæ, apice nunc mucronulatæ, biloculares, longitudinaliter dehiscentes; valvulæ æquales persistentes. *Capsula* initio  $\frac{1}{4}$ -supera, ibidem corticata minuteque ferrugineo-velutina, demum libera, bilocularis (loculis anticis posticisque  $\subset$  facile solubilibus) polysperma, incomplete septacidim bivalvis, valvis demum bipartitis, valvulâ alterâ stylo indiviso, vel ambabus stylo longitudinaliter bipartito apiculatis. *Septum* bilamellatum, basin versus eplacentigerum. *Placentæ* planiusculæ, læves. *Semina* numero indefinita, sæpissime omnia abortientia, uno plura numquam perfecta, pluriseriata, saltem medium placentæ versus, summo infimoque solitariis. *Sterilia* cujusque loculi numero variantia, a 29 usque ad 36, forsitan plura, valde difformia, varie angulata, cava, ossea, aspectu sub lente extus cellulosa, directione varia, superiora transversa, inferiora pendula (appensa); intermedia valde compressa. *Tegumenta* bina; *exterius* osseum, paginâ exteriore cellulosum, interiore ægre fibrosum; *interius* tenuissimum, celluloso-membranaceum, apicem seminis versus brunnescens, cavitate omnino nudâ. *Semen fertile*

solitarium, omnium extimum infimumque, pendulum (appensum), parieti loculi approximatum, extus convexiusculum, intus pressione angulatum, marginato-alatum, ab interiore latere visum aurem humanam apprime referens, ambitu irregulariter ovatum, brunneum, alâ lutescente. *Rapheos* situs lineâ angulis cæteris saturatius brunneâ indicatus. *Chalaza* inconspicua. *Foramen* superum, inconspicuum ob partium approximationem, oblique et interne situm, æquilaterale. *Tegumentum* duplex; *exterius* e membrana duplicata, tenuissima, decolorata, plicaturâ fibras plurimas, elongatas, lutescentes, longitudine variabiles fovente, margine fibris orbato sub lente pulchre crenato; *interius* tunc, celluloso-membranaceum, brunneum, albumen arcte vestiens, supra in collum productum breve, pressione complanatum, concolor, inter alæ fissuram foramen constituentem inclusum et nullo modo exsertum. *Albumen* parcum, carnosum, album. *Embryo* inversus, axilis, albus, longitudine et latitudine fere albuminis. *Radicula* supera, cylindræo-conica, cotyledonibus fere triplo brevior, basin colli membranæ interioris fere attingens. *Cotyledones* facibus seminis parallelæ, planæ, foliaceæ, ovales, venosæ, venis vix prominulis. *Plumula* inconspicua.

Obs. 1. These genera are nearly allied, although they differ importantly in habit, gemmation and stipulation, in the number of flowers entering into the composition of the capitula, in the dehiscence of the anthers, (so far at least as may be judged from the examination of the antheriform bodies of *Sedgwickia*) and in that of the capsules, in the number of abortive and perfect seeds and in the structure of their integuments.

2. Both agree remarkably with *Fothergilla* in the structure of the calyx, ovary, styles and stigmata, and *Sedgwickia* would appear to have an additional and very important resemblance in the dehiscence of its anthers.

3. They both likewise agree in a very important character, and one which has hitherto been considered as peculiar to naked-seeded orders. I allude to the punctuations, which are probably confined to the fibrous



tissue, and which are most abundant in Sedgwickia. These punctuations, at least those of Sedgwickia, are much smaller than those of Coniferæ, neither has the central areola that lucid appearance, which those of the latter have. In both genera they would appear to be arranged in single rows. But upon this subject I must abstain from making further remarks as I have no lenses with me on which I can confidently rely.

4. Bucklandia is remarkable for its curious ramification. I have invariably found that of the new branches, that which is opposite the terminal mature leaf is much more developed than any of the others, and this would appear rarely to produce flower-bunds. These being generally confined to the shorter branches.

5. This genus likewise departs from the usual character of the order in the quinary division of the hermaphrodite flowers; although the female flowers would still appear to be arranged in the usual quaternary one. The fact of the frequent and often incomplete transformation of the petals into stamina would appear to corroborate the opinion of M. DE CANDOLLE, that Fothergilla is apetalous from a similar but total and complete transformation. This idea will be much strengthened if some of the stamina of Fothergilla are solitary, while others are arranged in a double row.

6. The same genus is remarkable for the similarity that exists between the form of the lowermost ovula, and the same when developed into perfect seeds. I believe that the fact of the exsertion of the apex of the second membrane in the ripe seed has hitherto been unnoticed.

7. In conclusion I must observe, that the character of Hamamelidæ, as originally given by Mr. BROWN in the appendix to ABEL's China, will now require to be modified as regards the completion and composition of the flower, the number and situation of the stamina, the dehiscence of the anthers and number of the ovula. But it is a remarkable fact, that although the ovula are increased in number in Bucklandia and even indefinite in Sedgwickia, the perfect seeds are in both definite.

*PODOSTEMON*. Michaux.

Syst. Linn. *Monadelpia Diandria*.

Char. Gen. Flores nudi.

Ord. Nat. *Podostemeæ*, Rich.

Char Gen. Spatha tubulosa, monophylla, demum apice rupta, decidua. Stamina monadelpa, unilateralia; duo sterilia lateralìa, medium bicrus, biantheriferum. Stigmata bina inæqualia. Capsula costata bilocularis bivalvis, placentâ demum liberâ septis adnatâ, valvis parallelâ. Semina extus mucilaginosâ.

Plantæ evasculares, vel frondosæ, habitu Hepaticarum vel Fucorum quorundam. Spathæ pedunculorum elongatione ruptæ; axes inflorescentiæ unifloræ. Flores inconspicui.


Ob. Ex caractere Mniopsi affinis videtur et ob structuram exteriorem seminum Lacistemæ.

1. *PODOSTEMON WALLICHII*, R. Brown. Frondibus informibus ascendentibus sinuato-lobatis, floribus longe exsertis, ovariis sessilibus, stigmatibus conico-subulatis, capsulâ 8-costatâ.

*P. Wallichii*, R. Brown in Wall. Cat. no. 5225.

Hab. super saxis scopulisque rivorum et cataractarum *Churra Punjee* prope Moosmai et Mamloo. Legimus florentem fructiferamque mense Octobris 1835.

Planta parvula, altitudine extremâ vix uncialis, facie Hepaticæ cujusdam, dilute viridescens. *Frons* informis, adscendens, coriaceo-cartilaginea, sinuato-lobata, præcursa venis rectis e centro radiantibus, subopposite remosis, ramo unico ad florem quemque excurrente, inferne hinc illinc, sed præsertim centrum versus, ope radicum rupibus inundatis vel semi-inundatis arcte adhærens, superne et fere semper ad loborum sinus flores exserens. *Radices* interdum solitariæ, sæpius plures, centrales disciformes, hinc illinc radículas proferentes, exteriores ob frondis lobos adscendentes elongati, sæpe cylindracei, apicibus sub discoideis. *Folia* vera nulla. *Axes inflorescentiæ* marginales, e sinibus, rarius e disco exsertæ,

solitariae, sublineales, vestitae squamis 5—7 alternantibus, arcte distichis subequitantibus, subsecundis, forma irregulari, saepius angulatis, basibus facie externam plus minus inter se coalitis, texturam fere frondis sed magis carnosam coloreque magis herbaceo, venam unicam praecursis, demum deciduis, inferioribus minoribus et tantum ex facie antica axis conspicuis, interioribus spatham semi-amplectentibus; superne in pedunculos continuatae. *Spathae* tubulosae, celluloso-membranaceae, aveniae, apice dilatatae, initio clausae, ad anthesin apice irregulariter ruptae, pedunculorum partes inferas obvolventes. *Pedunculi* cylindracei, crassiusculi, ante ruptionem spathae flexuosi, ad anthesin fere subito exserti, maturitate longitudinem linearum 4 vix metientes, post anthesin peripheriam cellulosa decidua attenuati! filiformes, fere capillacei, indurati. *Flores* omnino nudi. *Stamina* unilateralia et semper externa quoad frondis centrum, ovario applicita, saepius 4, interdum 5; lateralialia abortientia, cellulosa, plano-setacea, apicibus subspathulatis introrsum saepe geniculatis, hinc ima basi cum centrali columnari e duobus tribusve filamentis coalitis formato connata. Columna introrsum arcuata, ovario paullo longior, subteres, crassisucula, glabra, apicem versus bifurcata in filamenta duo antherarum circiter longitudine, dorso centraliter et paullo infra bifurcationem stamen abortivum lateralibus simile saepe gerens. *Antherae* 2, (furcae cuilibet una) late ovatae, basi affixae, biloculares, fere didymae, longitudinaliter et introrsum dehiscentes, loculis insertione obliquis, ante dehiscenciam insigniter bilocellatis. *Endothecii* cellulae oblongae rotundataeve, inconspicue fibrosae. *Pollen* formae fere horologii arenarii, compositum e sphaerulis binis laevibus conatis, aqua immersis haud solubilibus. *Ovarium* semper internum, sessile, ovatum, glabrum, obsolete 8-sulcatum, biloculare, loculis anticis posticisque , septis tenuissimis facillime ruptis, placentam centrali, carnosam, septis adnatam, ovulis undique tectam. *Ovula* oo, adscendentia, minutissima, oblonga, viridescencia; tegumentum unicum, cellulosum, crassum, extus papulosum; foramen inconspicuum prope hilum; nucleus inversus, ovatus, apice obsolete mammillatus. *Stylus* subnullus. *Stigma* carnosum, sero deciduum,

profunde bilobum, lobis conico-subulatis inæqualibus per anthesin divaricatis, antea et postea incumbentibus, exteriore semper longiore et per anthesin inter crura columnæ recepto. *Capsula* lineam circiter longa, breviter stipitata pedunculo omnino denudato vel hinc reliquias parvas columnæ gerente, ovata, insigniter 8-sulcata (peripheriâ cellulosa e pedunculo continuatâ simul cum stigmatibus lapsâ) sulcis 6 in stipitem decurrentibus et basi e capsulæ parietibus liberis, his margines junctionis foliorum carpellarium indicantibus, geminatis et medio sulcatis; bilocularis, septidim bivalvis, valvis humectatis rectis, siccitate intus arcuatis! marginibus septorum reliquias gerentibus; endocarpio e cellulis minutis transverse dispositis formato. *Placenta* complanata, valvis parallela, demum libera, decidua, septis adnata et alato-marginata. *Semina* oo, minutissima, adscendentia, sæpius oblongo-ovata et utrinque attenuata, luteo-brunnescentia, exalbuminosa. *Raphe chalazaque* nullæ. *Testa* crassa, celluloso-rugosa, madefacta mucilaginosa et granulis minutissimis grumosa, immersione protractâ subsolubilis. *Tegumentum interius (nucleare)* celluloso-membranaceum, inconspicue areolatum, brunneum, apice obsolete mammillatum. *Embryo* dicotyledoneus, orthotropus, albus, cellulosus. *Cotyledones* plano-convexiusculæ. *Radicula* infera, hilo approximata, obtusa, cotyledonibus duplo brevior. *Plumula* inconspicua.

## 2. *PODOSTEMON GRIFFITHII*, Wall. Mss.

Fronde orbiculari depressâ, floribus semi-exsertis, ovariis stipitatis, stigmatibus cuneatis dentatis, capsulis 12—13-costatis.

Hab. Inveni florentem fructiferamque in saxis rupibusque seminundatis rivuli lente fluentis prope torrentem Bogapanee dictum, collium Khasiyensium, Novembri 1835.

Plantula minima, aspectu omnino fucoideo, saxis ope discorum (radicum?) floribus oppositorum firmissime et inextricabiliter adhæsens. *Frons* orbicularis, omnino depressa et saxis arcte applicata, lobata, coriaceo-cornea, superficie subsiliceâ, viridis, lucida, paullo viscosa, avenia! e disco promiscue et sine ordine axes inflorescentiæ numerosas exserens, lobo-

rum sinibus nudis. *Axes inflorescentiæ* super frondem depressæ, extrorsum inclinatæ, vix semi-lineales, supra in pedunculos continuatæ. *Squamæ* sub-senæ, virides, distiche imbricatæ, equitantes, ambitu oblongæ, angulatæ, substantiâ coriaceæ et angulum externum versus corneæ, interiores spatham semi-amplectentes. *Spathæ* facie superiore fissæ, margine inferiore integro rotundato coriaceo-corneo; cæterum membranaceo-aveniæ, pedunculos excedentes. *Pedunculus* inclusus, brevissimus, ovario brevior ut in præcedente, demum denudatus. *Flores* omnino nudi. *Stamina* semper externa, lateralibus abortiva, ovarium longitudine æquantia, apices versus geniculatim flexa, et apice imo recurvata. *Columna, antheræ* et *pollen* fere omnino ut in præcedente. *Endothecii* cellulæ vix fibrosæ. *Ovarium* breviter stipitatum, ambitu fere lanceolatum, compressiusculum, lineam circiter longum, biloculare, læviusculum, junius sessile rotundatum. *Ovula* oo, majora et angustiora quam in præcedente, cæterum omnino eadem. *Stylus* subnullus. *Stigmata* bina bilabiatis disposita, (antica posticaque) vix divaricata, cuneiformia, dentata, carnosæ, rubra, celluloso-papulosa, exteriori majore et furcâ columnæ amplexo; æstivatione supra antheras equitantes, demum simul cum peripheria cellulosa pedunculi ovariique decidua. *Capsula* sub-exserta, pedunculum denudatum terminans, breviter stipitata (stipite ovarii immutato) formâ ovarii, 12—13-costata, costâ superadditâ vel distinctâ vel sum alia confluenta, bilocularis, septocidim bivalvis, valvis siccatione intus arcuatis, unâ demum deciduâ (an semper?) Structura et placentatio præcedentis. *Semina* oo, oblongo-ovata, minutissima, adscendentia, utrinque attenuata. *Testa* cellulosa, crassa, immersa peripheriâ hyalina et quasi mucilaginis, intus lutescenti-grumosa. *Tegumentum interius* inversum, brunneum, celluloso-membranaceum. *Embryo* dicolyledoneus, orthotropus, cellulosus, albus. *Cotyledones* præcedentis. *Radiculæ* apex cum apice tegumenti interioris adhærens (ob immaturitatem). *Plumula* inconspicua.

Observation. In neither of the plants have I been able to ascertain the existence of any vascular tissue; the place of which appears

to be supplied by fibres of very small diameter packed very closely together, and, at least after maceration in spirit, filled with grumous matter. These fibres form the veins above described as existing in *P. WALLICHII*, which pass up along the centre of each axis of inflorescence, supplying in their course the scales, the column of stamina, and terminating by forming the costæ of the ovarium. But in *P. GRIFFITHII* these fibres are confined entirely to the axes of inflorescence; and although a branch appears to pass up along the staminal column, this appearance would seem to result rather from a discoloration of the tissue than from the presence of distinct fibres. The remainder of the fronds consist of dense cellular tissue, the cells varying considerably in shape and containing, particularly in *P. GRIFFITHII*, much granular amylaceous? matter. No stomata exist, although the distinctness of the cutis in the last mentioned species would lead one to suspect their existence. The spathæ appear to be the only entirely cellular parts. The roots of *P. WALLICHII* consist, like the peduncles of both species, of an outer cellular and a central fibrous portion.

In *P. GRIFFITHII* each axis of inflorescence is perfectly distinct; each arising from the parenchyma, the cells of which are there smaller and all converging towards the peduncle. Opposite to each of these points the fronds adhere so firmly to the bodies on which they grow, that it is almost impossible to detach them to any considerable extent. The adhesion is indeed so extraordinarily firm, that each disc on its detachment tears away with it a corresponding portion of the surface of the rock or stone on which the plant grew. On detaching the axes of inflorescence small round alveoli are left, penetrating or reaching to the disc of adhesion. This is very conspicuous in old plants, which appear like brownish, rather thick, frequently perforated films spread over the surface of the bodies to which they are attached.

The most remarkable points of structure are perhaps the composition of the pollen, and the deciduousness of the cellular portions of the peduncle and ovaria.

In describing these two species I have been guided by the fact that in some plants of the order the stamina are arranged all round the ovarium. But I am almost inclined to believe that the flowers are in reality unisexual.

The normal number of stamina is evidently five, the two intermediate ones being alone fully developed, and the central one often entirely wanting. The abortive stamina are entirely cellular, they are slightly constricted towards their points, the part above the constriction being obviously more cellular.

The plants of the order to which *PODOSTEMON* belongs, have such an anomalous structure that it is scarcely possible to assign to it any natural situation. The only points in which it agrees with some other dicotyledonous orders, are the absence of a perianth and the unilaterality of the stamina, which last character however does not seem to be of much importance. It is with much pleasure that I have been enabled to corroborate the accuracy of Dr. LINDLEY's inductions as to these plants being dicotyledonous; but it appears to me that they have no affinity with *PIPERACEÆ*. Dr. von MARTIUS has remarked at some length on the order in his *Nova Genera et Species Plant. Brasil.* 1, pag. 6, 7, and has touched upon its affinity with *LEMNA*; but his reasonings are founded upon the supposition of its being monocotyledonous. Putting this very strong objection aside, I think *PODOSTEMON* more allied to *PISTIACEÆ* than to any other known order.

#### KAULFUSSIA. Blume.

Ord. Nat. Filices. *Marattiaceæ*. Kaulf.

Syst. Linn. *Cryptogamia, Filices*.

Char. Gen. Capsulæ sparsæ, exsertæ, orbiculari-cyathiformes, multi-loculares. Indusium nullum.

Filices frondibus ternatis amplis, subtus stomatibus maximis apertis quasi perforatis, stipitibus basi bisquamatis, capsulis subsessilibus.

KAULFUSSIA ASSAMICA. Griff. Mssr.

Fronde triphylla, foliolis subsessilibus, stipitibus teretibus, capsulis sub-20-ocularibus, loculis per dimidiam longitudinem tantum deliscentibus.

**Hab.** In rupibus arenosis solo alluviali tectis Assamiæ Superioris, ad basin collium Nagensium Gubroo Purbut propinquis, ubi copiose invenimense Martii 1836. Umbrosissima amat.

*Rhizoma* subterraneum, longe repens, crassum, carnosum, infra radículas teretes, tortuosas, simplices ramosasve proferens, supra ad basin cujusque stipitis in squamas duas persistentes, carnosas, quam maxime papillosas (junioribus imbricatis conniventibus et frondem nascentem obtegentibus) quasi ruptum. Superficies papillis conicis magnis pilisque cellulosi irregularibus septatis asperata. *Stipes* pedalis, aliquando sesquipedalis, teres, basi incrassatus, papillis pilisque supra descriptis valde scaber, pilis rarius stellatis, sæpe ramosis, squamis badiis minimis peltatis raro immixtis. *Frons* ampla, ternata, ambitu deltoidea, novellæ gyratæ intra frondis substantiam formatæ, demum erumpentes pilis ramentisve rubris hispidissimæ. *Foliola* subsessilia, oblongo-ovalia, acuminata, carnosæ, sub-integra, supra sordide viridia lævia et glabrata, infra albida, oribus magnis elevatis innumeris stomatum officio fungentibus quasi papulosa, et ad venas, ultimis exceptis, modo supra descripto scabra, lateralia margine superiori obliqua. *Venatio*: *Venæ primariæ* (*costæ*) crassæ; secundariæ apices versus arcuatæ et ope venularum mutuo nexæ, vel magis distinctæ, apice utriusque cum vena secundaria superiore confluentæ; tertiariæ vix prominulæ; *intervenientia* cæterum varie irregulariterque reticulata; terminatio venularum ultimarum obscure clavata, vel intra-marginalis, vel intra arcolas. *Capsulæ* (*sori* cel. Kaulf.) maximæ, sine ordine evidente per totam paginam dorsalem frondis sparsæ, irregulariter seriatae vel sub-biseriatae, sitæ in confluentia venularum tertiariarum et ultimarum, subsessiles, cyathiformes, superficie externâ tot exarata sulcis quot locula, margine paullo incurvato sub lente crenato, crenaturis fissuris dehiscentiæ oppositis: loculis viginti vel ultra, verticalibus, ovatis, a medio supra usque ad apicem rimâ introrsum dehiscentibus, extus lutescentes, intus luteo-badiæ, utrinque rubro-punctatæ, siccatione rugosæ. *Sporula* in acervulo lutescentia, rotundata vel subreniformia, sub lente centies augente minutissime scabrella.



*Anatomia.* Radices cellulossæ, fasciculo vasorum unico centrali fibris circumato. Rhizoma e maxima parte cellulosum; cellulæ rotundatæ, pressione angulatæ, plurimæ, parvæ, succo rubro-rosaceo turgidæ; lacunæ paucæ interjectæ sine ordine evidente. Fasciculi vasorum plures, sparsi, peripheriâ fibrosi, centro ductiferi; ductibus plurimis, vix solubilibus, simpliciter trabeculatis. Stipes etiam e maxima parte cellulosus; cellulæ laxæ, pressione angulatæ, minoribus succo rubro-rosaceo effætis paucis et præcipue peripheriam versus sitis; lacunæ plures, sparsæ. Fasciculi vasorum subnoni, versus basin stipitis irregulariter, versus apicem hujus circa centrum dispositi, sectione transversâ oblongi vel subreniformes. Dispositio fibrarum ac vasorum eadem ac in rhizomate, sed vasa majora, ductusque solubiles, pseudo-fissi, compositi. Foliolorum cuticula utraque et præsertim inferior, quæ stomatosa, crassiuscula, e cellulis sinuosis globulas paucas virides minutas continentibus formata. Stomata (vel potius perforationes) maxima, sine ordine sparsa, in arcolis minutis solitaria, in mediocribus plura, rotundata, inæqualia, supra cuticulam elevata, oculis nudis facile conspicienda; oris margine e cellulis linearibus 3—4-seriatis annulatim dispositis formato, membranulâ marginali simplici? late crenatâ. Referunt omni sensu Hepaticarum quarundam stomata. Parenchymatis cellulæ ut plurimum rotundatæ, meatibus conspicuis interceptæ; cellulis cuticulæ stomatosæ propinquis laxissimis, quam maxime difformibus et lacunis amplis interceptis. Loculorum parietes proprii tenues, membranacei, moleculis minimis crebris interspersi.

Obs. For the knowledge of this plant being a *Kaulfussia*, I am indebted to my kind friend Dr. WALLICH. In my MSS. I had called its *Macrostoma* in allusion to its stomata, which so far as I know have hitherto been found only in the cuticulate genera of *Hepaticæ*; these organs M. KAULFUSS describes by the words “*vesiculis pertusis*.” I have described the capsule with reference to its appearance only: but it is at once obvious that the fructification consists of as many capsules as there are cells, united together by cellular tissue, which is deficient along their inner faces, but in this species only from their middle upwards.

The genus obviously belongs to the subtribe Marattiaceæ or Danæaceæ, in which M. KAULFUSS has placed it; the correctness of this is farther pointed out by the fact, that in Angiopteris the evolution of the young frond takes place in a similar manner, so far at least as may be judged from the universal presence of the two scales surrounding the base of the stipes in this latter genus.

M. BLUMES' species may be thus distinguished :

K. *ÆSCULIFOLIA* fronde ternatâ, foliolis petiolatis, laterali uno alterove geminato bipartitove, stipitibus hinc canaliculatis, capsulis subnovem-locularibus, loculis per totam longitudinem dehiscentibus.—K. *ÆSCULIFOLIA* Bl.—KAULFUSS in Hook. et Grev. Icon. Filicum vol. 2. Tab. 229.

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#### REFERENCES TO PLATES.

Plate XIII.\* Fruitbearing branch of *BUCKLANDIA POPULIFOLIA*; on the right side a branchlet with male flowers, both somewhat reduced; on the left a leaf, natural size.

Plate XIV. Analysis of the flower and fruit of *BUCKLANDIA POPULIFOLIA*.

Fig. 1. Hermaphrodite flower. Natural size.

2. Vertical view of a flower, most of the petals half transformed into stamina.
3. Vertical view of a normally developed flower; such are of very rare occurrence.
4. Petal.
5. 6. Ditto half transformed into stamina.
7. Ditto, transverse section.
8. Anther with portion of filament, viewed from before.
9. Ditto ditto behind.
10. Ditto after dehiscence.
11. Ditto representing the mutual approximation of the valves.
12. Transverse section of anther.
13. Pollen.
14. Capitulum of female flowers.

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\* By mistake this plate and plate XV. have been marked W. Griffith del., instead of Luchman Sing del.

**Fig. 15. Female flower separate, ovarium removed.**

16. Outer view of placenta removed from the ovaria, representing the situation of the ovula of one cell.
17. Lateral view of three ovula of one side of the cell of the ovarium, removed with portion of the placenta.
18. One of the middle ovula viewed on its inner face.
19. Do. the second integument, enclosing the nucleus.
20. One of the lowermost and perfect ovula, inner face.
21. Do. viewed laterally.
22. Do. upper part of outer integument cut away, exposing the upper part of the second coat, within which is seen the apex of the nucleus.
23. Mature fruit, several times enlarged.
24. Transverse section of a capsule.
25. Longitudinal do. running through both cells, and exposing the situation of the lateral seeds of each, the base of the perfect ones alone visible.
26. Fruit, natural size; more of the ovaria in this case are abortive than usually happens; one of the capsules has fallen off.
27. Inner face of upper abortive seed.
28. Long section of one of the middle do. shewing it to be solid.
29. Inner face of perfect seed.
30. Long section of do. wing removed almost entirely, apex of the second coat exposed.
31. Embryo.
32. Neck of the second integument, highly magnified.

All with the exceptions of No. 1 and 26 magnified.

**Plate XV\*. Fruit bearing branch of *SEDGWICKIA CERASIFOLIA*; natural size.**

**Plate XVI. Analysis of the fruit of *SEDGWICKIA CERASIFOLIA*.**

**Fig. 1. Fruit several times enlarged.**

2. Ditto long section through the centre.
3. Longitudinal section of a capsule through both cells; seeds in one cell remaining in situ, of the other removed.
4. Transverse section of a capsule.
5. Seeds of one cell removed in situ, viewed on the outer face.
6. Capsule after dehiscence, removed.
7. Inner view of half the preceding, separated along the septa.
8. Ditto outer view.
9. 10. Sterile seeds.

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\* See Note at the preceeding page.

Fig. 11 Long section of a sterile seed towards the middle of the placenta, shewn to be lined by a membrane.

12. Outer view of lowermost and perfect seed.
13. Inner of ditto.
14. Ditto ditto longitudinal section, neck of the second integument exposed.
15. Portion of the outer integument, highly magnified.
16. Embryo, one cotyledon removed.
17. One of the persistent anthers.
18. Ditto, transverse section.

All the above more or less magnified.

Plate XVII. Left half. *PODOSTEMON WALLICHII*.

- Fig. 1. Axis of inflorescence in a young state with a portion of the frond.
2. Ditto more advanced.
  3. Ditto ditto after the dehiscence of the anthers.
  4. Flower viewed laterally; one of the abortive stamina in situ, the other displaced.
  5. Ditto viewed on the outer face.
  6. Abortive anther.
  7. Pollen; the lowermost represent two after immersion in water.
  8. Transverse section of ovarium.
  9. Young ovule.
  10. Ditto a little more advanced.
  11. Mature ovule; outer coat half cut away longitudinally, exposing the nucleus.
  12. Capsule at the period of dehiscence.
  13. Ditto after dehiscence in the dry state.
  14. Seeds.
  15. Seed moistened.
  16. Ditto after immersion in water.
  17. Ditto immersed in water and slightly pressed.
  18. Embryo.

Plate XVII. Right half. *PODOSTEMON GRIFFITHII*.

- Fig. 1. Axis of inflorescence in a young state, upper or inner face.
2. Ditto ditto outer or under face.
  3. Flower of ditto detached, outer view.
  4. Column of ditto with portions of the two lateral stamina, inner view.
  5. Upper view of axis of inflorescence during flowering.
  6. Ditto ditto, under view.
  7. Outer view of perfect flower, lateral and abortive stamina displaced.
  8. Transverse section of anther before dehiscence.
  9. Pollen.

**Fig. 10. Ovulum.**

11. Ditto, longitudinal section exposing the nucleus.
12. Nucleus detached.
13. Capsule viewed laterally.
14. Ditto dehiscent, in the dry state and one of the valves nearly separated.
15. Placenta.
16. Seed.
17. Inner integument enclosing the embryo.
18. Embryo.
19. Ditto, cotyledons displaced.

**Plate XIX. KAULFUSSIA ASSAMICA.**

The figure on the left exhibits the fern, reduced; the detached frond on the right is of the largest natural size.

- Fig.**
1. Portion of the frond viewed on its inferior or dorsal face.
  2. Capsule viewed vertically and on its lower face.
  3. Ditto ditto upper face.
  4. Ditto longitudinal and central section.
  5. Ditto transverse section towards the middle.
  6. Portion of the membrane of the cells.
  7. Sporules viewed as opaque bodies.
  8. Ditto immersed in water.
  9. Long section of a portion of the frond carried through one of the stomata.
  10. Stoma viewed vertically and exteriorly.
  11. Long section of the apex of a rhizoma.
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X.  

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N O T E  
ON THE  
F O S S I L C A M E L  
OF THE  
SIVÁLIK HILLS.

BY HUGH FALCONER, M. D.,  
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AMONGST the most interesting of the Fossil remains of Mammalia, which have been found in the Siválik strata, the Camel may undoubtedly take up a high position. Independently of the speculations which the remains of this genus would lead to, relatively to the form and features of the country previously to their entombment, the circumstance of the Camel having been up to this period a desideratum in Fossil Zoology adds very considerably to the interest of the present discovery.

The only\* remain which we find noted is in CUVIER's Ossemens Fossiles, where a reference is made to the *Merycotherium Sibericum* of M. BOJANUS,

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\* Ossemens Fossiles tom 5, part ii., page 507. Besides the *Merycotherium*, CUVIER also notices in the same article a fossil femur, of which he says "qui ressemble aussi beaucoup, dans ce qui en reste, à celui d'un chameau." A drawing of the specimen, which was found near Montpellier was sent by M. MARCEL DE SERRE to CUVIER. Our information does not extend later than the third edition of the Ossemens Fossiles in 1825.

which CUVIER decides to be an undoubted species of Dromedary : this remain consists of three teeth brought by a merchant from Siberia : the place or stratum in which it was found is unknown, and CUVIER's remark—" Si les trois dents que M. BOJANUS vient de publier sont effectivement fossiles," throws an uncertainty even on its antiquity.

In the identification of the Siválik fossil there can be no doubt ; and although we should have preferred delaying this paper until we had procured a perfect skull, we may perhaps be excused for entering upon the description, since the portions of the skeleton we already possess, including parts of the skull, are sufficiently marked to remove all doubts on the animal to which they belonged.

The Camel is placed in systematic arrangements at the head of the Ruminantia. In common with the rest of the family it has a compound stomach. Its molars have the form characteristic of Ruminants, and its skeleton generally is constructed on the same plan. But the skull differs very materially in form from that of the horned Ruminants ; and we see in the less complete ankylosis of the metacarpal and metatarsal bones, and in the greater division of the carpus and tarsus, an approach to a higher family among the Mammalia. The anomalous character of the pseudo canines, the presence of incisors in the upper jaw, the thickness of skin and horny soles of the feet, shew a strong affinity with the Pachydermata. This affinity is greatest with the Solidungula which the Camels approach by their more divided carpus and tarsus ; while the former approximate to the Camels by their soldered metacarpals and metatarsals.

In drawing a comparison between the skull of a Camel, and that of a horned Ruminant, the peculiarities of the former are exhibited in the great width and massiveness of the cranial portion, contrasted with that of the muzzle, which is slender ; the position of the orbit is more central and its edges more prominent, owing to the elongation of the cranium and to the greater development of the temporal fossa.

We cannot do better however than follow CUVIER in his observations on the same subject; who, in drawing his comparison with the separate bones of the head, remarks—"In the true Camels the occipital crest is more elevated, and the temporal fossæ more hollowed than in the Lamas; this development being nearly as great in the Camel as in the Carnivora, the occipito-temporal suture is considerably in front of this crest; the nasal bones are narrower at their bases, and a much larger space intervenes between the small membranous portion situated at the angle of the nasals, and the lacrymal bone, a very small portion of which is exposed, and which does not even extend to the internal sub-orbitary foramen in the orbit." These remarks are applicable to the Ruminants generally as well as to the Lamas, although the passage from which we have made the quotation is intended for the latter: we may add two other points in which a marked difference exists between the skull of the Camel and the horned Ruminants. 1st, in a greater depth of maxillary bone, and a consequent elevation of the nasals. 2d, in the external nasal aperture being provided with three pairs of bones, the nasals and intermaxillaries being separated; this intervening space is a general feature in the Camel, although subject to great variations in extent. We have seen specimens with the nasals and intermaxillaries separated by a space of two inches; and others again with only one quarter of an inch of the maxillary bone appearing on the nasal aperture. In the horned Ruminantia this peculiarity is only observable in the Yak and Auroch.

We have considered the above observations applicable in pointing out the differences that exist in the osteology of the Camel's head and that of other Ruminants, previous to entering upon the teeth; as with these two points fully explained, the identification of our fossil is placed beyond all doubt, and it will only remain then for us to shew the differences which it exhibits.

It has been before noted that the anomalous character of the teeth is one of the points connecting the Camel with a higher family. The molars



however are, as is normal in Ruminants, in number twenty-four; six on each side in the upper, and the same in the lower jaw. The first molar, which from having the simple and pointed form of a canine tooth has by some Naturalists been termed a second canine, is one of the chief peculiarities of the Camel. It is situated at some distance from the remaining molars, which, in number five, are in a continuous series; in the lower jaw the 2d molar or that which may be considered the first of the series, is described by CUVIER as falling out at an early age: and not being replaced, it leaves a series of four teeth only.

We have examined a number of skulls of the common or Arabian Camel, and have only found one example of the existence of this 2d molar in the lower jaw; the series in all other cases consisting of four, with a wide intervening space between the 1st and 3d. That it is a part of the true series is undoubted from its existence in the specimen above alluded to. It is exceedingly small and rudimentary. Its position is central on the space between the 1st and 3d of the whole series.

The skull in which we have observed this small and deciduous tooth is from a fine specimen of the Camel procured at Hissar. The animal to which it belonged was full grown, we should say somewhat passed the adult state, judging from the bones of the cranium being ankylosed and a consequent absence of sutures. There is a greater development of all the distinctive characters in this specimen in depth of maxillaries; comparative dimensions of the cranial and facial portions, &c. arising from the superior growth to which the animal has attained, and to the superior class of animal from which it was selected; and the space occupied by the maxillary bone in the external nasal opening is also smaller than we have observed in any other specimen.

In the upper jaw the line of molars consists of one sharp pointed tooth similar to a canine, and situated at some distance in front of the others, which are in a continuous series; the two first being single barrel'd, and the three last, or the three true molars, double barrel'd.

In the lower jaw a sharp pointed tooth, corresponding with that in the upper jaw, is situated in the same way ; and takes the place of the first in the series. The intervening space between this and the continuous line contains the second or small deciduous molar. The remaining four teeth are placed together, the first of these (or third of the whole series) consisting of a similar cylinder, and the three permanent molars as is usual with the Ruminants, being double barrel'd with the exception of the last which is triple barrel'd. Finally, as in the Sheep and Antelopes, the cylinders are well defined, and without any approach to accessory pillars.

There are two canines in the upper jaw, as we find in another section of the Ruminantia.

The presence of incisive teeth in the upper jaw is peculiar to the Camel as a Ruminant. Of these teeth there are two, corresponding in position to the outer incisors, and similar in form to the canines. In taking a lateral view of the skull this similarity of form in the incisor, canine, and first molar, gives the appearance of three canines in the upper jaw.

In the lower jaw there are, as is normal in the family, eight incisors, differing in form from those of other genera ;—the outer ones taking the simple and pointed form as described above, and the six intermediate ones being more regular in proportions than is usual in Ruminants, and having on each side a nick or hollow on the grinding surface.

The teeth of the Camel then are as follows :

*Upper Jaw*—2 Incisors.

2 Canines.

12 Molars, two of which are pointed and have been termed second canines.

*Lower Jaw*—8 Incisors, two of which are pointed.

12 Molars, two of which are pointed, and two deciduous at an early age.

The chief peculiarities of the skull are—

1. Narrowness of muzzle.

2. Advanced position and prominence of orbits.
3. Elevation of sagittal and occipital crests and development of temporal fossæ.
4. Narrowness of nasal bones at the posterior extremity.
5. Extreme depth of maxillary, producing an arched appearance in the nose of the animal.
6. Form of sphenoid and basillary portion.
7. Number of bones on the external nasal aperture.

This summary brings us at once to the comparison of our fossil species with the existing Camelidæ.

In pursuance of the rule that we have proposed to follow in naming the new species so as to ally them at once to the mountain series, whence their remains have been obtained, we propose calling the largest and that nearly approaching the Indian species, *Camelus Sivalensis*: to the second or a smaller species, the description of which we shall enter upon more fully hereafter, and which may perhaps have been more closely allied to the Lama, we propose the name of *Camelus Antiquus*.

#### CAMELUS SIVALENSIS.

Of the *Camelus Sivalensis* we draw our description from the remains both of the skull and of the bony structure of the animal generally. We have at present only portions of the skull to guide us. The remains of the lower jaw however are perfect, including the coronoid processes. The articulating ends of bones are in sufficient abundance, and in a sufficient state of preservation, to enable us to form a very tolerable idea of the size and height to which the animal must have attained.

To commence with a comparison between the fossil skull and that of the *Dromedarius* or common Camel in use in the Bengal Provinces. From the imperfection of our fossil fragments, and the sutures not being distinctly traceable in most cases, we must be satisfied with a view, limited more

to the general character than to the detailed boundaries of the bones ; yet it is fortunate, that in some cases where these boundaries are especially required as a distinctive character, as in the naso-frontal and naso-maxillary suture ; our fragments, imperfect as they are, have been provided with them.

The form of the skull, position of sutures (as far as our fossil fragments exhibit), and the teeth both in number and character, very closely resemble the existing species above referred to. We draw our comparison from a fragment consisting of the posterior portion of the nasals and maxillary bones with the frontal to the posterior border of the orbits. This fragment would alone establish the generic position of the animal, and in the absence of a perfect skull we could not have possessed a specimen more applicable to our present purpose. This fragment in fact contains three of the most prominent points in which the Camel differs from all other Ruminants : here we have the contrasted breadth of the frontal and facial bones, the extreme narrowness of the posterior extremity of the nasals, and the great distance between that point and the anterior border of the orbit, distinctly shewn. In the fossil there is a strong resemblance in all these points to the species now existing ; the swelling of the frontal is as highly developed, and the deep superciliary notch as well defined. The narrowness of the nasal bones on their approach to the frontals is well marked, as also that space occupied by the membranous portion in rear of the nasal bones, and the superciliary foramina correspond in size and position, being placed as remote from the orbit as in the living animal. In viewing this fragment laterally we observe that the orbit has an excess of length on its antero-posterior diameter, the orbit of the existing Camel being either a perfect circle, or having the excess of length in its vertical dimension. The mutilated state of this fragment—(see Figs. 1 and 2, giving an upper and a lateral representation of the fossil) does not admit of remark or comparison further than that the animal to which it belonged was far advanced in age, and had

arrived at that period and state of dentition when the obliteration of the crescentic lines was complete, and when the grinding surface consisted of ivory with an imperfect margin of enamel. The second and third false molars, or those with a single cylinder, are here in position; exhibiting a remarkable affinity to those in the existing Camel both in form and in the contrasted obliquity of wear (to front and rear respectively in the first and second teeth,) which is such a peculiar feature in the old animal.

Fig. 3, is a representation of another fragment; both jaws locked together, but the anterior and posterior extremities, with the upper surface of the skull, wanting. The animal from which this remain originated, was young—its ultimate permanent tooth not completely developed, and the third milk molar still in position. The general character is that of the present Camel, the form of maxillaries, thickness of lower jaw and external appearance of teeth corresponding as closely as two skulls of one species would do in the animal now existing. The position of the sub-orbitary foramen, however, is rather higher up on the maxillary, and the diminution in depth or tapering of the lower jaw is not so considerable as we observe to be the case in the existing Camel.

Fig. 4, gives us a still further insight into the form of the head of the fossil Camel. The lower jaw (with the exception of the upper portion of the ascending branches including the condyle and coronoid processes) is quite perfect; and the lines of molars of the upper jaw are also in position. Here we may express a regret on the want of careful superintendence in excavating and removing these fossils from the stratum. It is possible in the present case that the whole of the upper portion of this specimen might have been obtained had proper care been taken in removing the circumjacent matrix. It will be seen that the upper portion has been as it were cut off on a line with the alveoli of the upper molars, leaving not only them but also the upper canines in position.

Fig. 5, represents the lower jaw of the existing Camel, and placed in juxta position with the fossil will convey a tolerable idea of the form and character of both. The measurements of the lower jaws are annexed.

DIMENSIONS, LOWER JAW.	FOSSIL.		EXISTING FROM HISSAR.		EXISTING FROM SEHÁ- RANPUR.	
	<i>Inch.</i>	<i>Metre.</i>	<i>Inch.</i>	<i>Metre.</i>	<i>Inch.</i>	<i>Metre.</i>
1. Extreme length from alveolus of incisors to rear of ramus, .....	16.8	.428	15.0	.382	15.2	.387
2. Ditto expanse of alæ to the rear, .....	8.1	.25	6.4	.162	6.2	.157
3. Ditto length of symphysis, .....	5.4	.116	5.325	.135	4.95	.125
4. Width of jaw over 1st or pointed molar, ..	2.1	.052	1.95	.050	2.0	.050
5. Length of molars in series, .....	5.9	.15	5.4	.137	5.2	.132
6. Distance between 1st or pointed molar and the 3d or 1st of the series, .....	2.95	.075	2.575	.065	2.6	.066
7. Extreme depth of ramus at the ascending angle, .....	4.25	.108	—	—	4.0	.101

This fossil is the remain of a very old animal ; the canines and pointed teeth are worn down to a flat surface, and the molars which can be partially examined, from the circumstance of the two jaws having been fossilized obliquely on each other, appear to have lost all their enamel excepting the exterior border. We before stated that, although the cranium and facial bones were entirely removed, the lines of molars on both jaws were in position ; the animal had partly from age and partly from accident, lost the first molar from the right side of the upper jaw. This tooth must have dropped out at an earlier period than nature had ever intended, and the coronal surface of the corresponding tooth in the lower jaw for want of the wear which it ought to have had under the natural course of detrition is distinctly marked with its crescentic lines of enamel. The fall of the tooth has further led to a tendency on the part of the rear teeth to incline forwards and partially occupy its place ; this inclination had so far advanced, as to prevent the posterior cylinder of the tooth in the lower jaw from undergoing any change, the front and foremost cylinder only of this

penultimate tooth having undergone this singular alteration and arrived at this diseased form.

In referring to the table of measurements above given, the excess in size of the fossil is the most prominent feature, but the relative dimensions of the different parts, with one exception, bear a close affinity to those of the existing Camel. In the jaw of the latter there appears to be a greater depth at the alveolus of the ultimate molar on the commencement of the ascending branch, which may possibly result in some degree from age, and the more perfect development of the teeth; but in other respects the resemblance is striking. The exception to which we refer is in the second measurement, shewing the breadth between the rami or ascending branches to the rear, a difference of some importance, as it involves in the structure of the cranial portion of the skull an increase of width, and a greater distance between the articulating or glenoid surfaces for the condyles of the lower jaw. We are borne out in the correctness of this inference, by the remains of our second species of Camel, which fortunately is very perfect in the cranium, and where the breadth and form of this region in comparison with that of the existing Camel are very different. To this, however, we shall refer in its proper place, satisfying ourselves with the conclusion that the *Camelus Sivalensis* and the *Camelus Antiquus* corresponded in this respect, and that the former differed from the existing Camel in the form and excess of width of the cranium. In comparing the teeth of the fossil represented in Fig. 4, with those of the *Camelus Dromedarius* we observe no difference excepting that which may have arisen from their difference in age. That of the fossil must have been considerable, as may be observed in the wear, and flattened surface of the fourth or pointed incisor. The intermediate incisive teeth have been slightly disarranged in the matrix; and it will be observed in the drawing that one of these teeth has been displaced and is now situated above, imbedded in the rock. The grinding surfaces of all the incisors are much worn, and all marks of the lateral nick completely obliterated. On the opposite side to that represented in the plate the canine

tooth of the upper jaw is situated in position with its point downwards, imbedded in the mass of matrix, which it may be observed reposes on the anterior parts of the fossil. This canine is much worn both on the point and on the anterior side; and its resemblance to that of the Camel of the present day is sufficiently close to make any further comparison unnecessary.

Figs. 6 and 7 are portions of the lower jaw of the skull, a fragment of which is represented in Figs. 1 and 2. The mass from which these remains were recovered was carefully broken up by ourselves, and the broken pieces united afterwards. A great portion of the cranium appears to have been disintegrated and so mixed up with the matrix, as to make all attempts at a separation ineffectual. The anterior part of the lower jaw has suffered in this way, but the extreme good fortune of rescuing that portion represented in the figures above alluded to, consisting of the rami of both the right and left side with the condyles and coronoid processes entire, is ample compensation for the loss, more especially as the incisive extremity was already in our possession, and we were only in want of the articulating and coronoid processes to complete the jaw. The difference in form of the fossil will be observed on a reference to Fig. 5, which is a representation of the lower jaw of the existing Camel. In giving the measurements we place in juxta position those of the Hissar and Seharanpur Camels before referred to, and to facilitate reference have defined the boundaries of our lines of measurement by capital letters.

	FOSSIL.		EXISTING HISSAR.		EXISTING SEHARAN- PUR.	
	<i>Inch.</i>	<i>Metre.</i>	<i>Inch.</i>	<i>Metre.</i>	<i>Inch.</i>	<i>Metre.</i>
Total depth from top of coronoid process to lower border of jaw, or from A. to D.,.....	8.3	.211	9.2	.233	7.9	.20
Ditto from surface of articulating condyle to lower border of jaw, or from B. to D.,.....	5.45	.138	8.1	.205	6.4	.162
Ditto from heel to lower border of jaw, or from C. to D.,.....	3.6	.091	6.0	.152	4.7	.119
Depth from A. to B. or from top of coronoid process to upper margin of articulating condyle, .....	2.85	.072	1.1	.028	1.5	.038
Breadth of condyle on transverse measurement,	1.7	.044	1.65	.042	1.6	.041



The fossil ramus has more the form of that of the Ox than of the Camel ; the slenderness of its proportions resembles that of the Cervidæ more than of the Camelidæ to which it belongs : and were it not for the heel or step on the posterior ascending margin which as the generic mark establishes its position, we should have been at some loss in recognizing as the remain of a Camel, a fragment bearing in its external appearance so strong a resemblance to the Ox, Deer or Antelope. Independent of the heel, the Camel now existing, is rather peculiarly formed in this part in comparison with other Ruminants. The Buffalo is that which has the nearest approach to it. In the existing Camel, the ascending branch rises at nearly a right angle from the line of jaw ; it has considerable breadth on its antero-posterior dimension, and its coronoid process is short, straight and massive. In the fossil Camel the ascending branch is as oblique as in the Ox ; it has no excess of breadth on its antero-posterior dimension, and its coronoid process is long, slightly curved back, and slender. Here are points of difference sufficiently striking—but there is a still further difference in the form of the condyle—that of the fossil having a much longer transverse diameter than in the existing Camel ;—its proportions are much more slender, and the depression on its upper margin much deeper. We may remark however that the slenderness of the fossil condyle is only comparative, with reference to that of the same genus now existing, and that it bears no resemblance whatever to the condyle of either the Buffalo, Ox, or other Ruminants. The condyles of the two former are much slighter and the upper articulating surface much narrower than in the Camel.

On the peculiarity of form above described as appertaining to the ramus of the lower jaw, we are naturally struck by the close resemblance it bears to that of the horned Ruminants, and its marked variation from the same bone belonging to the Camel of the present day : and we should be inclined to refer to the extreme length of the coronoid process as a point tending in all probability to unravel the mystery, were we not struck with the discre-

pancies that appear even amongst animals of the same species, in the length and dimensions of this process.

The length and breadth of the coronoid process appear to be distinguishing features in all animals where there is a great depth of the temporal fossa and great elevation of the zygomatic arch ; and also in those animals possessing the power of great lateral motion of the condyle in the glenoid cavity. Amongst the former may be included all the Carnivora and predatory animals : amongst the latter the Ruminantia, to which only we shall at present refer, although there appears to be considerable obscurity on the changes that modification of form of this process entails upon the physical economy of the animal.

The Capridæ, including Antelopes, appear to have the coronoid process more developed than the Bos ; the Bos more than the Camel. We observe that this process in the common Goat, *C. Hircus*, is long and broad, and in the *A. Chikarra* long but narrow, in the *A. Tetracornis* it is short. In two specimens of the male and the female of the Nilgai (*A. Picta*, PALLAS), we observe that the female has exceedingly a long coronoid process, much curved to the rear ; whereas that of the male is short, straight and pointed. We could give additional instances were it necessary for a want of any rule of uniformity, in fact the inferences of the value of this process in establishing any peculiarity in the organization of the masticatory faculties, appear to us, as we before noted, to be clothed in considerable obscurity.

With these remarks on the osteology of the head, we will after the following Table, shewing the comparative sizes of the ultimate tooth in the upper jaw of a number of fossils compared with that of the Camel now existing, proceed to the rest of the bony structure, which, from the strong resemblance that exists between the fossil and modern types, will occupy but a small space.

*Comparative dimensions of the ultimate or third permanent molar in the upper jaw of the Fossil and of the existing Camel.*

DIMENSION.	EXISTING HISSAR.		FOSSIL 1ST.		FOSSIL 2D.		FOSSIL 3D.	
	<i>Inch.</i>	<i>Metre.</i>	<i>Inch.</i>	<i>Metre.</i>	<i>Inch.</i>	<i>Metre.</i>	<i>Inch.</i>	<i>Metre.</i>
Length on its antero-posterior } measurement, .....	1.75	.044	1.90	.049	2.00	.050	2.00	.050
Breadth on its greatest lateral } bulge, .....	1.00	.025	1.35	.034	1.25	.032	1.20	.030

Of the vertebral column we possess a very perfect atlas with part of the axis attached to it.—The form is precisely that of the corresponding vertebra of the existing Camel, with the exception of an increased development to the ridge on the lower side, and a consequent increase of depression of the lateral surfaces in which the arterial foramina are situated. The shortness of the wings and the conical form of the atlas correspond with that of the existing Camel.

Of the axis, we have only a mutilated specimen, the posterior portion is altogether wanting, but the remainder is similar to that of the present Camel.

We possess a number of the lower extremities of both the humerus, and the radius and ulna; some of them in connected joints, others separate; but we have not been able to detect amongst the numerous fragments in our possession, the connecting pieces by which the bone in its whole length could be established. We see no difference whatever in these fragments, and in their articulating ends from those of the existing animal. The ankylosis of the radius and ulna is as complete; the surfaces for the articulation of the scaphoid and cuneiform bones as flat and unmarked by a hollow; and the lower extremity of the ulna is as destitute of an

external process for embracing the cuneiform bone of the carpus as the existing Camel.

The carpal bones are equally correspondent both in form and number—the small bone in rear of the os magnum and connected bone having the same marked and spherical headed articulation with the scaphoid.

We now come to the metacarpal bone, of which we have a very perfect specimen attached to the end of the radius and ulna by the intermediate carpal bones. We see no difference in form and no peculiarity requiring remark. We derive data however from this for establishing the comparative size to which the Sivalik Camel arrived—our dimensions are placed in juxta-position with those of a full grown and common sized Camel of the present day :

	FOSSIL.		EXISTING.	
	<i>Inches.</i>	<i>Metres.</i>	<i>Inches.</i>	<i>Metres.</i>
Extreme length of metacarpal bone from its articulation } with the carpals to articulation with the phalanges,... }	18.85	.470	15.85	.403

The extent of non-anchylosis, and the form of the pullics for articulation with the phalanges, and the phalanges themselves, appear to correspond, and to be equally characteristic in both the fossil and the living Camel.

With the posterior extremities we are not so well provided, and shall content ourselves with a reference to the femur only, of the lower end of which bone we possess a variety of specimens ; of the largest of these we annex the dimensions :

	FOSSIL.		EXISTING.	
	<i>Inches.</i>	<i>Metres.</i>	<i>Inches.</i>	<i>Metres.</i>
Extreme transverse breadth in condyles,.....	4.9	.124	4.7	.118
Ditto breadth from front to rear, .....	5.4	.137	5.1	.130
Ditto breadth between condyles, .....	0.675	.0165	1.075	.027

With the exception of the proximity of the condyles to each other in the fossil, there is no marked difference; all the hollows and protuberances on the bone of the existing animal have their corresponding ones on the fossil. The femur in its length also appears to have had as great a curve forward as we observe in that of the Camel of the present day.

This brings us to a conclusion on the comparative differences between the *Camelus Sivalensis* and the *Camelus Dromedarius* now existing. Although the fossil fragments from which this comparison has been derived are not either so perfect or so numerous as we could have wished, they are still sufficiently so for every purpose of comparison, and in some cases we have been even struck with the remarkable perfection of the fossil, considering its soft and in many cases imperfectly indurated quality, added to the intimate combination with, as well as adhesion to, the matrix, which consists of a light colored clay with a small admixture of sand.

In recapitulation of our above remarks, therefore, we will note that independent of the peculiarities described as existing in the cranium of the *Camelus Sivalensis*, upon which peculiarities we rest its specific character, there must have been others in its external form. These differences however could not have extended far: its general character must have borne a close affinity to that of the same animal of the present day, and although we have proofs of its size having exceeded our existing Camel in a proportion equalling at least one-seventh of its height, we are unfortunately ignorant of the effects that domestication may have caused in the deterioration or otherwise of the *Camelus Dromedarius*; especially in a country and amongst a race of people who pay little attention to the improvement whilst the natural increase is sufficient to supply their wants and add to their comfort. The *Camelus Dromedarius* from which our comparison has been drawn must not be confounded with the *Camelus Bactrianus* or Camel used by the Arabs.

For the Camel in all its perfection we must seek the shores of the Caspian, to the hordes and wandering tribes who from generation to generation have looked upon this animal as the only means by which they

could exist, as the only means by which communication could be maintained over oceans of sand and miles of desert. If any care be given to the breed of the Camel in its domestic state, we should expect to find it in this quarter; but among the people of India who use the animal merely as a beast of burthen, and carry on the breed much in the same way as they do with their other domesticated animals, we have no reason to expect any improvement. In the Government stud we have no doubt that all feasible means are exerted to improve the breed, or at least to prevent deterioration by maintaining a stock from the largest and finest grown animals. It will be noted that one of the skulls referred to in this paper is from the stud, and the person to whom we are indebted for its use as a means of comparison described it as having belonged to a very large male Camel: but here also we see no great difference in size, although there are differences in the greater development of the bones of the head and face. The constant influx of Camels in the whole sweep of the Indus and its branches from *Ludiana* to *Shikárpur*, or even to the Indian ocean, most undoubtedly keeps up the supply, but does not add anything to the improvement of the species. Indeed, we are inclined to consider that the Camel has deteriorated in size from that to which it attained in its wild and natural character, and should our inference be correct, the dimensions obtained from the comparative measurement of the bones of our fossil species, may lead to a very tolerable idea of the size to which the Camel reached, when unshackled by the trammels of man, and leading its existence in the wilds of its own native region.

We regret our inability, from want of specimens, of adding to this comparative statement, the dimensions and peculiarities of form of the Bactrian or true Camel with two humps, *Camelus Bactrianus* of authors. The *Camelus Dromedarius* or the Dromedary with one hump is the animal from which we have drawn our description. In STARK'S Natural History the former is stated to be the *longest* of the two—*Camelus Bactrianus* being described as "about 10 feet long," and *Camelus Dromedarius* as "nearly 8 feet long." We are not aware of the limits upon which the above measurements are

drawn; but in taking those of a perfect vertebral column from the atlas to the last caudal vertebra of the common sized *Camelus Dromedarius*—we obtain a measurement of 9 feet 10 inches, including the head. The total length of the *Camelus Dromedarius* is 11 feet 4 inches, and this must be considered as under the full measurement, from the absence of inter-vertebral cartilages which connect the vertebræ in the living animal. STARK's specific character evidently leaves an impression of a superiority of size in the *Camelus Bactrianus*. We learn from ELPHINSTONE, in his history of Caubul, that the height of the latter animal is considerably less; that it is shorter and stouter; well adapted for rocky and hilly countries; and from its shortness of limb, less liable to accident, than its tall and slenderly formed congener.

On the Camels in *Afghánistán*, the author above mentioned, remarks—“The Dromedary is found in all the plain country, but most in sandy and dry parts; this is the tall long-legged animal common in India. The Bactrian Camel (which I understand is called Uzhree in Toorkee,) is much more rare, and I believe is brought from the Kuzzauk country beyond the Jaxartes. He is lower by a third at least than the other, is very stout, and covered with shaggy black hair, and has two distinct humps, instead of the one bunch as the Dromedary. The Boghdee Camel, in the south-west of Khorasan, is shaped like the last mentioned, but is as tall as the Dromedary. Even this last varies; the Dromedaries of Khorasan, being lower and stouter than those of India.”\* Again—“Many Dromedaries are bred here, or at least by the tribes whose residence is partly in Damaun. They are much darker in color than the common Camel, have shorter and stronger limbs, and are far better calculated for work among hills.”†

It would appear from ELPHINSTONE's remarks that there are three species of Camel—

1st.—That which has obtained the specific denomination of *Camelus Dromedarius*—tall, slender, with one bunch, and common to India.

\* ELPHINSTONE's Caubul, 2d edition, 1819, vol. 1, p. 280.

† Ditto ditto, ditto, vol. 2, p. 72.

2d.—*Camelus Bactrianus*, or the Bactrian Camel, which is one-third less in height than the former one, stout, covered with black hair, and with two distinct humps.

3d.—The *Boghdi Camel* resembling in shape the Bactrian, but with the height of the Dromedary or *Camelus Dromedarius*.

The Khorasan Dromedary may be considered as a variety of the 1st species or *Camelus Dromedarius*, with less height but stouter proportions.

In GRIFFITH'S Translation of the *Régne Animal*, notice is drawn to a third species distinct from the Bactrian and Arabian Camels in the possession of RUGUERE; of this third species however the characters are not given. HAMILTON SMITH in GRIFFITH'S CUVIER\* divides the genus into the two species, *Bactrianus* and *Dromedarius*; considering these as the parent stocks from which a number of breeds and varieties have sprung, "all nevertheless depending on the very trivial distinctions of color, size and form:" but the specific characters of these parent stocks differ very materially from those derived from ELPHINSTONE'S work before alluded to, most especially with reference to the *Camelus Bactrianus* described by that author as one-third lower in height than the Arabian Camel. HAMILTON SMITH† says in describing the *Camelus Bactrianus*, "his height may be considered superior to the Arabian, and the bulk of his body more considerable. The large breed of this species attains seven feet and a half from the top of the hunches to the ground, the legs are proportionately short, and the body long." The height of the Arabian Camel, according to the same authority, does not exceed seven feet, "those of Turkey are the strongest and the best suited for burthen, those of Arabia and Barbary the lightest; and those of India, where there are breeds for both purposes constantly supplied by fresh importations from the North West, yet probably inferior in their class to those more in the vicinity of their original climate."

\* Vol. 5, p. 298, Synopsis Mammalia.

† Vol. 4, p. 48.



We have been desirous of ascertaining the excess of height to which the existing Camel arrives, to form a correct opinion of the proportionate size of our fossil species, and for this purpose have consulted those authorities from whom it was most likely to draw accurate information. The accounts are sufficiently conflicting, but that of GRIFFITH, as an authority on a point of natural history, may be considered as the best, and the most properly to be depended upon : assuming therefore that the comparative heights and proportions of the *Camelus Bactrianus* and *Camelus Dromedarius* as shewn by GRIFFITH are the true ones, and that the latter is of a smaller size than the Bactrian Camel, we are still borne out in our conclusions with regard to the excess of dimensions of the fossil or *Camelus Sivalensis*, and that this excess applies generally towards all the species of Camel now existing.

*Northern Doáb, July 15, 1836.*

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#### REFERENCES TO PLATES XX, XXI, OF CAMELUS SIVALENSIS.

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|---|------|---|
| Appertain-<br>ing to the<br>skull Fi-<br>gured in<br>1 and 2. | Fig. | 1. View of portion of skull of <i>Camelus Sivalensis</i> from above.  |
|   |      | 2. Ditto ditto lateral view of Fig. 1.  |
|   |      | 3. Side view of another portion of skull of <i>Camelus Sivalensis</i> with lower jaw attached.  |
|   |      | 4. Side view of lower jaw of ditto with the molars of the upper jaw in position.  |
|   |      | 5. Side view of lower jaw of existing Camel ; <i>Camelus Dromedarius</i> .  |
|   |      | 6. Side view of ditto of <i>Camelus Sivalensis</i> right side, exhibiting the peculiarities in form of the ascending branch and the coronoid process. |
|   |      | 7. Side view of ditto ditto left side.  |
|   |      | 8. Portion of lower jaw <i>Camelus Sivalensis</i> right side inner view.  |
|   |      | 9. Ditto ditto left side outer view.  |
|   |      | 10. Ditto ditto ditto inner view of No. 9.  |
|   |      | 11. Ditto ditto right side outer view.  |
|   |      | 12. Fragment of upper jaw <i>Camelus Sivalensis</i> , shewing the ultimate and penultimate molar of the left side.                                    |
|   |      | 13. View of No. 12, exhibiting the inner side and coronal surfaces of the molars.   |
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XI.

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NOTE

ON THE

FELIS CRISTATA,

A NEW FOSSIL TIGER,

FROM THE

SIVÁLIK HILLS.

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By HUGH FALCONER, M. D.,  
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AND  
CAPTAIN P. T. CAUTLEY,  
*Superintendent Doáb Canal.*

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To the large fossil species of the genus *Felis* hitherto described, we are now enabled to add another from the Tertiary Strata of the Sivalik Hills, differing alike from the *F. Spelæa* and *F. Antiqua* of the "Ossements Fossiles;" and, (so far as our means for comparison enable us to judge) from every known member of the genus.

The specimen from which we take our description, is one of the most perfect that has up to this time been exhumed from the fossil tract. It was found at the foot of a sandstone cliff, partly encased in a hard stone matrix. It consists of a nearly entire head; deficient only in the temporal apophysis of the left zygomatic arch, and in a small portion of the sagittal crest. The incisors had dropped out, but the alveoli are sufficiently distinct to indicate their number and relative size. The cheek teeth are

nearly entire but the canines are broken off at their bases. The fragility of the specimen has deterred us from removing a portion of hard stony matrix which fills up the right zygomatic fossa, and conceals the base of the skull from the anterior margin of the occipital foramen on to the posterior border of the palatine bones.

(Plate XXI. Fig. 1.) Represents the head in profile and shews the peculiarities of the fossil in the most striking light :

1st. The relative shortness of the facial portion of the head, from the post-orbital apophyses of the frontal (*a*) to the border of the incisives; and the length of the cranial portion from the same point (*a*) to the occipital crest (*b*); the dimensions being as 124 to 153. In this respect it differs from all existing species, in which, as exhibited by CUVIER,\* the facial portion of the head exceeds the cranial, generally, to a considerable extent.

2d. The outline of the upper surface of the cranium and face. The facial line (*c a*) runs with a gentle curve, slight convexity and nowise serpentine, to the rear of the post-orbital apophyses of the frontal. The cranial line meets it without angularity, and runs back horizontally to the occipital crest: so that when the head is seated on the occipital condyles and carnassier teeth, the plane of the base of the cranium is parallel to that of the vertex. In this respect it differs remarkably from all known large species of *Felis*, in which the cranial line descends more or less either in a curve or slope, from the post-orbital apophyses to the occipital crest.

3d. The saliency of the sagittal crest which greatly exceeds that of all known *Felinae*. It is partly broken off in the original, but the dotted line marks its direction.

4th. The height of the occipital, which is relatively greater than in any other known species of the genus.

5th. The elevated position of the zygomatic arches, and the strongly arched outline of their inferior margin.

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\* Ossements Fossiles, Vol. 4, p. 147.

Viewed from above (Fig. 2.) the contrasted proportions of the cranium and face are well exhibited. The muzzle is short. The canine region of the maxillaries swells greatly out in the bulge of the alveoli, and between it and the malars, the infra-orbitary hollow is more abrupt and deeper than generally holds in the large *Felineæ*. The nasals are short and broad. The brow is wide. The intra-orbitary region of the frontal is marked by a deep longitudinal hollow. The post-orbitary processes of the frontal and malars are blunt and little projecting. The post-orbitary ridges of the frontal meet at a very acute angle, leaving between them a well defined and narrow furrow. The length and prominence of the sagittal crest and the height of the occipital crest are strongly apparent. The parietals are seen to bulge out little towards their upper margin, but considerably towards the temporals.

Our means for comparison of the fossil with most of the large *Felineæ* are restricted to the figures in the Ossements Fossiles, which however are so perfect and characteristic, as to admit of the chief marks of distinction being very readily seized. Of all the large species, the specimen most closely resembles the Tiger, although considerably smaller in size and perfectly distinct otherwise. The chief points of resemblance in both, are the great developement of the sagittal and occipital crests; the considerable surface of the occipital; the moderate convexity of the brow and face; and the elevated position of the zygomatic arches and the outline of their inferior margin. To exhibit the peculiarities of the fossil we shall now give its dimensions in juxta-position with those of two of the largest sized Tigers, killed in the forests near *Sháranpúr*, and of a younger animal almost exactly of the size of the fossil. The amount of wearing in the cheek teeth,

and the condition of the sutures prove that the fossil was full grown although not aged.

	FOSSIL TIGER.		LARGEST TIGER No. 1.		LARGE TIGER No. 2.	
	English Inches.	French Metre.	English Inches.	French Metre.	English Inches.	French Metre.
1. Extreme length from occipital crest to alveoli of the incisors, . . . . .	10.9	.278	14.1	.358	13.1	.333
2. Ditto from anterior margin occipital foramen to ditto, . . . . .	9.0	.228	11.7	.298	10.8	.274
3. Extreme breadth of head at zygomatic arches, . . . . .	8.0	.203	9.55	.242	10.0	.253
4. From posterior border of palate to the alveoli of the incisors, . . . . .	—	—	6.3	.180	5.9	.149
5. From anterior margin of nasals to occipital crest, . . . . .	9.2	.233	12.4	.314	11.85	.300
6. From border of post-orbitary process to ditto, . . . . .	6.0	.153	7.5	.191	7.0	.179
7. From ditto to the alveoli of incisors, . . . . .	4.9	.124	6.6	.168	6.1	.156
8. Extreme height from base of occipital foramen to occipital crest, . . . . .	4.1	.103	4.2	.106	4.2	.106
9. Width between outer surfaces of occipital condyles, . . . . .	2.2	.055	2.3	.058	2.45	.062
10. Ditto of occipital foramen, . . . . .	—	—	1.15	.029	1.25	.031
11. Height of ditto, . . . . .	—	—	0.8	.020	0.8	.020
12. Ditto of cranium from middle of frontal to the palatine arch, . . . . .	—	—	4.6	.117	4.25	.108
13. Breadth on maxillaries between the canines and molars, . . . . .	3.0	.076	3.7	.093	3.5	.088
14. Extreme length of 2d and 3d molar, . . . . .	2.2	.055	2.32	.059	2.2	.056
15. Breadth of maxillaries to rear of carnassier, . . . . .	4.5	.114	5.4	.138	5.6	.142
16. Depth of infra-orbitary foramen, . . . . .	0.75	.018	0.7	.017	0.7	.017
17. Width of ditto, . . . . .	0.3	.007	0.4	.010	0.375	.0094
18. Length of the nasal bones, . . . . .	2.8	.071	4.2	.106	4.1	.104
19. Length of carnassier tooth, . . . . .	1.5	.038	1.4	.035	1.375	.034
20. Width of frontal between the post-orbitary apophysis, . . . . .	3.1	.078	4.2	.106	3.65	.092
21. Length from frontal angle to base of the nasals, . . . . .	2.9	.073	3.6	.090	2.0	.073

We shall now make a comparison of the peculiarities of the individual bones of the head with those of the Tiger. This will make the points of difference in the fossil more apparent.

The dentition of the fossil is as is normal in the genus. There are six alveoli for the incisors—the two outer of which are greatly larger than the intermediate which are equal in size. The canines are broken off at their

base; and the section is seen to be the same as in the Tiger. The cheek teeth had consisted of two false molars, a carnassier and a tuberculous tooth on either side. The tuberculous and the first false molar had dropped out. The socket of the tuberculous tooth is distinct on one side. Those of the first false molars are more ambiguous. In all the specimens of the *F. Spelæa* observed by M. GOLDFUSS,\* this false molar was invariably wanting, and he was induced to consider it as a specific distinction of the fossil. But CUVIER attributes its absence to dropping out at an early period.

In our fossil we were at first led to think that there was no small false molar, from the very contracted space between the canine and the large false molar not admitting of room for it. In the fossil the space is 0.3 inch whereas in the Tiger it is 0.7 inch. But on carefully clearing the interval we have detected on the left side an alveolar cavity. In this respect therefore the fossil does not differ from the existing large species.† The great false molar and the carnassier tooth resemble in form, those of the Tiger exactly. But they differ considerably in two respects which we consider as distinctive marks of the fossil. 1st, The length of the two teeth in the fossil is exactly equal to that of the full grown Tiger No. 2, although it measures 10.9 inches in length of head, while the Tiger is 13.1 inches; 2d, the large false molar is directed inwards, so that its long axis makes a considerable angle with that of the carnassier. This position of the false molar holds in a slight degree in the genus *Felis* generally, but it is very marked in the fossil.

The obscurity of the sutures, and the extent to which the fossil is still enveloped in stone, do not admit of our determining precisely the limits of many of the bones of the cranium and face.

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\* Quoted in CUVIER Oss. Fossil. Vol. 4, p. 452.

† The presence or absence both of the tuberculous and the first false molar, appears to be very uncertain in aged *Felinæ*. In a very old Tiger, No. 1, of the measurements, with the canines and all the teeth much worn, both the tuberculous teeth, and the small false molar of one side are present. Upon the opposite side all trace of alveolus has disappeared. Whereas in younger animals with unworn teeth, we find the tuberculous, and first molars, less complete.

The *frontal* is considerably shorter than in the Tiger of the same size No. 3, and broader; so that it has more squareness of form, at the same time that the ridges stretching from the post-orbitary processes by their prominence and greater convexity inwards, give it an appearance of more sharpness to the rear. These processes are more obtuse and less salient than in the Tiger, and the outline of the frontal portion of the orbit is less curved. The separate halves of the bone are convex across leaving a deep longitudinal hollow between.

The *parietals* are longer than in the Tiger. They are sunk towards their commissure, giving greater appearance of saliency to the sagittal crest. They bulge out, at their junction with the *temporals* in conjunction with these bones. The sagittal crest, as noticed above, from its great prominence, is one of the most distinctive characters about the fossil. It is nearly twice as much raised, as in the largest sized Tiger. Its anterior extremity for a short way divides in two, from running in continuity with the post-orbitary ridges of the *frontal*.

The *occipital* is large in all its dimensions. It greatly exceeds that of the Tiger of the same size in height, and equals that of the large Tiger No. 2. Its margins expand greatly, laterally, in conjunction with the ridge, ascending from the petrous portion of the *temporal* bones.

The *temporal* on the right side is mostly concealed by stony matrix. On the left it is broken at the zygomatic process. The petrous is comparatively larger than in the Tiger. The zygomatic arch is elevated and its lower margin is arched more decidedly than in the Tiger. (In this respect it resembles the "Black Jaguar."\*) The posterior angle is more acute.

The corresponding process of the malar differs chiefly from that of the Tiger in the post-orbitary apophysis being blunt and very slightly prominent.

The *nasal* bones are considerably shorter than in the Tiger, and they taper less upwards towards their frontal insertion.

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\* Oss. Fossil. Vol. 4, Plate II. W., Fig. 7.

The *maxillaries* chiefly differ from those of the Tiger, in their greater prominence along the alveoli of the canines, and the more decided hollow which occupies the infra-orbitary region. From the elevated direction of the zygomatic arches, the posterior margin of the maxillaries, descending from the malars is higher than in the Tiger. The infra-orbitary foramina agree in form and position with those of the Tiger.

The ascending apophysis of the incisive bones, runs higher up between the nasals and maxillaries, giving thus a stronger insertion to the bone.

We do not observe any very appreciable difference in the palate, except that the bulge of the canines, and the inward direction of the large false molars, appear to contrast it in width between this teeth.

The orbit is smaller than in the Tiger; the post-orbitary processes of the malars and frontal are more apart, and the osseous ring consequently less complete.

Regarding the relations of the fossil with respect to other species.—

The fossil Lion of GAYLENREATH, *F. spelæa*, differs from it, in the great size, equalling that of the Lion in the outline of the head; breadth of forehead; depth of zygomatic arches; position of the infra-orbitary foramina, and inconsiderable sagittal crest.

The fossil *F. Antiqua*, differs in being greatly smaller. The existing Lion is much larger, differing also in its rectilinear profile, shortness of head, and want of prominence in the sagittal crest and occipital.

The points of distinction and resemblance with the Tiger have been noticed in detail.

The Panther somewhat resembles the fossil in the moderate convexity of the head, but differs in size and in the little prominence of the sagittal crest. The Jaguar has the same elevated direction of the zygomatic arch, as the fossil, but differs greatly in the outline and form of the head.

The Cougar has one character peculiar to it and the fossil in the genus; in the face being shorter than the cranium. But it differs in size and form.



The other species of the genus differ at once in size.

We have named the fossil, the *Felis Cristata*, from its most prominent character, the elevation of the sagittal crest.

Its position in the genus will probably be after the Tiger. Its size is intermediate to that species and the Jaguar.

We are indebted to WALTER EWER, Esq. of the Civil Service, for an examination of the fossil, which was found by collectors employed by that gentleman under the direction of Captain CAUTLEY.

*Northern Doab, April 15, 1836.*

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## XII.

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### NOTICES

OF

## THE ORNITHOLOGY OF NÈPÁL.

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By B. H. HODGSON, Esq.,

*Resident at Katmandu.*

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### I.—EIGHT NEW SPECIES OF CINCLOSOMA,

WITH SOME REMARKS ON THE GENUS,

*Order* INSESSORES. *Tribe* DENTIROSTRES.

*Family* MERULIDÆ. *Genus* CINCLOSOMA.

THE elegant and philosophical VIGORS has lately characterised a new Genus of Meruline birds to which he has given the name of *Cinclosoma*. Mr. VIGORS justly observes that this genus is clearly separated from *Turdus* by rounder, feebler wings; a longer, laxer, and graduated tail; and higher and stouter tarsi. Without pausing at present to enquire whether the group (which is certainly a just and natural one) belong rather to the Meruline or Corvine family, or, whether it has been characterised with sufficient precision, at once, and latitude, I shall merely observe that according to my experience the *minutely* exact form of the tarsi, the nostrils, and wings cannot be relied on;\* and that the group, considered as contrasted

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\* That is, tarsi more or less smooth or rough: the precise relation of length between some dozen of the wing feathers: and the precise form of the nasal aperture. But perhaps the real explanation of these differences is, that the value of the group has been underrated.

with that of the true Thrushes, is as distinctly marked by the stomach, the bill, and the frontal zone, as by the wings, tail, and feet. The stomach has double the muscular power of the same organ in *Turdus*, approaching to a true gizzard: the straight compressed bill, inclining to a tetragonal form, has the tomia nearly in contact with the palate in both mandibles; and the nares are partially or wholly concealed by a setaceous frontal zone, analogous to that of the *Corvidæ*.

The birds composing the group or genus are gregarious, noisy and alert. They frequent the deep and dank forests and groves exclusively; procure the greater part of their food on the ground; use the trees but for security when disturbed, for nidification, and for occasionally eking out their repasts with berries, pulpy fruits or caterpillars; and are, for the most part, incapable of a sustained flight. Their habitat is very extensive, since they are almost equally common in the southern, central, and northern regions of these hills; and in the valleys alike, as on the tops of the mountains. In all situations, however, wood-lands are indispensable to them, both for food and shelter; especially the latter, their retreat being a mere succession of hops from tree to tree, after the manner of the Magpies. Most of them have a good deal of the mixt weariness and familiarity, as well as of the noisiness and congregational habits, of the *Corvidæ*; and, though they never quit the deep wood-lands, those persons who pass through such places, perpetually encounter them on the roads and pathways, to which these birds are attracted by the dung of cattle, for the grain, larvæ and insects it affords them. They are on the whole, rather insectivorous than frugivorous, baccivorous, or graminivorous: but they eat a deal of grain and hard seeds, with gravel to digest it; and must, from the universality of their regimen, be classed among the omnivores. They are distinguished from the Thrushes by their avoidance of rills and swamps;

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SWAINSON, justly perhaps, classes the *Cinclosomæ* with the *Crateropodinæ*. But he unjustly reduces them to a sub-genus. This paper was penned before I had seen SWAINSON'S casual allusion to the group in the birds of America. That able writer is most correct in stating that the characters of *Cinclosoma* and of *Pomatorhinus* stand in grievous want of revision.

and they are more capable of a graminivorous diet than that group. They scrape the earth with their bill, and sometimes also with their feet, in the manner of the *Rasores*. Many of the species are caged and tamed with facility; and they are more often turned loose into walled gardens; whence they seldom attempt to escape, if there be a considerable number of trees, and where they are of great service in destroying pupæ, larvæ and perfect insects, especially those which are generated, or feed, in manure.

In the Minister's garden at Cathmandu there are always several scores of *Leucolopha* (*Corvus Leucolophus* of Hardwicke;) and in that of his nephew, many individuals of each of following species—*Ocellata*, *Albigula*, *Rufimenta*, *Monilegera*, and *Erythrocephala*. But this enumeration reminds me that I am anticipating by the mention of several species as yet undescribed, and to the summary description of which I now proceed, premising only that the newly described species are *Leucolopha*, *Erythrocephala*, *Variegata*, *Ocellata*, *Capistrata*, and *Lineata*. To these I now purpose to add *Nipalensis*, *Albigula*, *Monilegera*, *Rufimenta*, *Grisauris*, *Melanoura*, *Cerulatus*, and *Setafer*, arranging them in a series indicative of the gradually diminishing power of the wing.

1st. *Species*, CINCLUSOMA? NIPALENSIS Nobis, SIBIA? NIPALENSIS Nobis.

Above, with the flanks, thighs, vent and under tail coverts, rufescent sub-olive brown. Below, and the cheeks, sordid blue grey, with a yellowish tint: wings and tail castaneous with numerous cross bars of black: entire top of the head full pure brown, streaked down the shafts with hoary: a broad black moustache, bounding the ear coverts below. Remiges and rectrices, internally blackish, and apertly so towards the tips: the tips themselves of the tail feathers white: head with a full soft garruline crest: legs flesh-coloured: bill dusky: iris brown: orbits clad: sexes alike, as in all the subsequent species.

N. B. In defining the Genus *Sibia* (Nobis) I have enumerated the above as one of the species. It has, though in a less degree, the brushed tongue of that genus: its wings are rather feebler: and its bill is more straight. The tomæ are scarped, and the notch and bend of the upper mandible are

palpably developed. The lunated, unplumed, nares, with a large adpressed membranous tect, are those of *Sibia*. So are the feet ; which latter, however, agree sufficiently well with those of *Cinclosoma*.\*

The species is, in fact, osculant between *Cinclosoma* and *Sibia*. Size, 8 inches long by 10 wide, and  $1\frac{1}{2}$  to  $1\frac{3}{4}$  oz. in weight. Tarsus  $1\frac{1}{2}$  ; central toe  $\frac{1}{16}$  ; hind toe  $\frac{1}{18}$  ; wings not bowed ; 5 and 6 quills longest : tail firm but gradated,  $1\frac{1}{4}$  inch in the extreme laterals.

*Species 2nd.* CINC. ALBIGULA, white throated Cinclosoma, Mihi.

Above, and the breast, dull olive : belly, vent and under tail-coverts, rusty : chin to breast, inferiorly, and terminal  $\frac{1}{3}$  of the lateral rectrices, pure white ; bill dusky : iris glaucous : orbital skin green : legs plumbeous grey, 12 inches long by 15 broad ; and  $3\frac{3}{4}$  oz. in weight.

N. B. This species, like *Leucolopha*, has much the appearance of a Jay : but it possesses in a high degree, all the characteristics of *Cinclosoma*, of which more is said in the sequel.

Nares ovoid or elliptic, and frequently quite hidden by the frontal zone.

*Species 3rd.* CINC. GRISAURIS, grey-eared Cinclosoma, Mihi.

Above, save the neck, olive, with a rusty smear : neck, throat and flanks, pale rusty ; rest of body below, white : cheeks, ears and lores grey, enclosed by two narrow black lines which originate at the bill, and circling round the eyes and ears, unite into a broad band on the sides of the neck, and thence form a gorget on the *top* of the breast : terminal  $\frac{1}{3}$  of the lateral rectrices doubly banded with black and white, as in *Ocellata*, but the bands broader : bill, dull horn : legs plumbeous : iris brown : orbital skin, greenish yellow : 13 by 17 inches, weight 6 oz.

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\* Exaggerated mention has been made of the feet of *Cinclosoma*, and some species have been again separated, propter hanc causam, from *Cinclosoma*. But in truth, the feet agree most expressly with those of *Pica Erythrocephala*, *Vagabunda*, &c. It were much more wise to amend the definition of *Cinclosoma* than thus to divide it. In no species is the thumb nearly so large as the central fore digit ! The *Cinclosomæ* are a half Corvine, half Meruline group, united by their manners even when partially separated by their structure. They compose a genus with sundry subgenera. B. H. H. July.

N. B. The upper mandible is sometimes produced, bent, and notched at the tip, even more than in *Turdus*.

Nares ovoid, partially hid by setæ from the frontal zone.

*Species 4th.* CINC. MONILEGERA, black-necklaced Cinclosoma, Mihi.

Extremely like the last in colours. Above, pale olive brown ; whole neck, with the throat, breast and flanks, rusty ; and rest of the body below, white : a broad superciliary white line from the bill to the occiput : below it a black line proceeding from the bill through the eyes and ears (which latter are black,) and thence sweeping round the *bottom* of the breast like a necklace : iris orange : bill dusky with horn coloured tip and base below, and plumbeous grey feet : orbital skin evanescent :  $11\frac{1}{2}$  by  $14\frac{1}{2}$  inches, weight  $3\frac{1}{4}$  oz.

Nares as in the last ; and all the three last named species closely assimilating with *Leucolopha*.

*Species 5th.* CINC. MELANURA, black-tailed Cinclosoma, Mihi.

Head, neck, and body, olive brown, lunated with black : brows and chin, black : wings black internally, visibly so in the tertiaries : edge of the primaries cerulean ; of the other quills and of the coverts, castaneous : rump immaculate : tail black with a complete terminal band of rusty : feet fleshy brown : bill black : iris marine blue : length of the bird  $10\frac{1}{2}$  inches : breadth 12 : weight  $3\frac{1}{2}$  oz.

N. B. The maxilla of this species has usually the meruline bend and notch : the nares are ovoid somewhat indented above by the membrane, and free from the frontal zone. The wings are rather rounder than in the three preceding species.

*Species 6th.* CINC. CÆRULATUS, blue-sided Cinclosoma, Mihi.

Above, rich olive brown, with a chesnut tinge : cap, wings and tail, chesnut ; the first, lunated with black. Below, white : the flanks and tibiæ, blue : a black frontal zone from the eyes : body, wings, and tail, immaculate : bill dusky with a purplish fleshy base : orbital skin purpurescent : iris brown : legs fleshy white : 11 inches by  $12\frac{1}{4}$  ; weight  $2\frac{3}{4}$  to 3 oz.



N. B. In this species the shorter and more rounded nares are *wholly* hidden by the setaceous frontal zone ; and all the remiges, save the 5 first and 5 last, are nearly equal. The mandibles of the bill are exactly equal and entire, eminently typical.

*Species 7th. CINC. RUFIMENTA*, rusty-chined Cinclosoma, Mihi.

Above, olive brown, broadly lunated with black : entire cap black : tail immaculate, but furnished towards the tip with a double band of black and rusty, prevailing throughout : chin and vent rusty : throat white : breast and belly smokygray with black drops : lower part of the flanks and thighs, olive brown ; bastard-wing, and external edges of primaries, subcerulean : the former and the long coverts, tipped with black bar-wise : a pale roundish spot before the eyes : broad longitudinal black patch behind the gape : bill horn yellow : orbital skin splendid blue : iris sanguine-brown : legs fleshy brown : 10 inches by  $10\frac{3}{4}$  ; weight  $2\frac{1}{2}$  oz.

N. B. In this species the nares are not wholly hidden, but they are even less elongated than in the last : the wings are very feeble and perfectly round : bill, as in the preceding species, but shorter.

*Species 8th. CINC. SETIFER*. Spiny Cinclosoma, Mihi.

Slaty blue, overlaid with ruddy brown, which is clearer and paler below, and richer and almost castaneous on the wings and tail-feathers. Lateral rectrices broadly banded with black towards the tips : the tips themselves bluish grey : shafts of the feathers on the head and neck, rigid, spinous and black : elsewhere, albescent and soft :  $8\frac{1}{2}$  inches by 9 ; weight  $1\frac{1}{4}$  oz.

N. B. In this somewhat anomalous species the tomæ are scarped internally as well as less near to the palate or more locked than in any of the preceding species, and the upper mandible, rather longer than the lower, has *always* the meruline bend and notch. The nares are short and ovoid, free from the frontal zone, and more shaded above by the membrane. The stomach, which is gradually more muscular in the two last species, in this reaches the form of a true gizzard almost.

The rotundity and feebleness of the wings are carried to the extreme limit.

In the four first species the wing, though rounded, has yet something like acumination in the prime quills. That character begins to disappear in the 5th and 6th; and is wholly lost in the 7th and 8th species. *Quoad hoc*, the four first assimilate with *Leucolopha*, and the two last with *Erythro-nota*; the 5th and 6th being transitional. The whole eight have points of difference among themselves which perhaps may be best explained by the assumption that the group (already loaded with species recent as is its institution) is really of more extent than a genus, or at least forms a genus with several subgenera. Certainly, the Pic-like and Thrush-like species form a bold and decided contrast. *Leucolopha*, *Albigula*, *Gristauris* and *Monilegera* belonging to the former division. The essential characters of the genus appear to me to be as follows: An elongate conic bill, framed as to length and thickness upon the Meruline model, but distinguished from that of *Turdus* by its straightness, by the pent roof, rather than convex, shape of its maxilla; by the tendency to equality and entireness in both its mandibles, and, above all, by the palate being produced almost to the cutting edges which yet are trenchant throughout; fossed and membranous nares, the apertures of which are almost or wholly hid by a setaceous frontal zone: nude orbits: soft, rounded, and feeble wings: a longish, gradated, bowed, and feeble tail: high, stout, corvine, legs and feet, the thumbs of which are large and partially flat-soled, as in *Corvus*, *Pica*, *Garrulus*, &c., but not in *Turdus*. In the general form of the wings, tail, and feet, there is a much closer connexion with *Pica* and *Garrulus* than with *Turdus*. And this corvine analogy is strengthened by the anteal development and setaceous character of the frontal zone of feathers; by the partial nudity of the orbits; by the similarity of the sexes; by the manners, the voices, and the soft discomposed plumage of the *Cinclosomæ*; and, lastly, by the considerable muscular power of their stomachs and omnivorous regimen. But, on the other hand, the thick



massive bill, notched and bent in both mandibles ; the unfossed nares ; and the short, half-fleshy tongue of the *Garruli* and *Picæ*, no way consort with the structure of the same parts in the *Cinclosomæ*, which, in each of these respects, bear a distinct affinity with *Turdus*, and, more generally, with the *Merulidæ*.

June 1836.

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## II.—NEW SPECIES OF THE THICK BILLED FINCHES.

ERINGILLIDÆ—COCCOTHAUSTINÆ.

Genus COCCOTHAUSTES ?

Species, new. COC. MELANOZANTHOS, Black and yellow Finch, nobis.

*Form*: bill exceedingly gross, as high as long ; tips of both mandibles compressed, mutually bent and notched ; upper mandible arched along the culminal and rictal lines, strangulated and furnished with a large tooth at the base ; lower mandible wider at the base than the upper, and flattened beneath. Nares remote, ovoid, opened laterally at the lower end of a basal transverse membranous groove ; their aperture hid by hairs. Wings long and firm, reaching to middle of tail : 2d quill usually longest : primaries nearly twice as long as tertiaries, and very firm. Tail distinctly forked. Tarsi low, stout, heavily scaled, longer than any toe : toes medial, unequal, stout ; fores compressed ; hind depressed ; external fore basally connected : nails stout, falcate, moderately acute.

*Colour and size* :—Male.—Above, with the entire head and neck, slaty black ; below, bright yellow : long coverts of the wings tipped broadly with yellow, and a broad stripe of the same on the outer edge of the secondaries and tertiaries : a white speculum on the primaries, next to the false wing : bill and legs, plumbeous : iris, brown. Female,—much more variegated : wings and tail as in the male : top of the head and dorsal neck,

dark like the male, but entirely enclosed by a yellow band proceeding from the brows over the eyes and down the neck to the back, where the opposite lines are blended and form yellow margins to the dorsal plumes : a broad dark line from the nostrils through the eyes to the scapulars, which are immaculate. Below this line all the inferior surface is yellow ; but there is a dark line from the gape and another from the lateral angle of the lower jaw, on each side, enclosing an immaculate chin. Below the chin the yellow ground is varied with longitudinal drops of the dark hue of the upper surface, save on the centre of the lower belly, vent, and under tail coverts, which are immaculate yellow as in the male : bill, legs and iris, as in the male, but duller. Size of the male, 9 inches long by 15 wide, and 3 oz. in weight : female, rather less.

The young till after the second moult resemble the female, taking the full adult plumage gradually.

These birds belong to the northern region, whence however they wander into the central, even in summer, in search of ripe stony fruits.

Their structure is by no means typical, and I have noted them as the type of a new Genus under the revived name of *Stobilophaga*.

*Species 2nd*—CARNIPES. Fleshy-grey footed Finch, nobis.

Head, neck and breast dusky slaty, striped on the lower half with hoary : upper back, wings and tail dusky ; the first smeared all over, and the two last edged, with greenish yellow : a white speculum on the primaries, as in the last : lower back, belly and vent, greenish yellow : under tail coverts the same, dashed with dusky : legs and bill fleshy grey : iris brown. Sexes alike ; size rather less than the last.

*Genus* CORYTHUS ?

*Species 1st*—C. SIPAHI, nobis. Seapoy Corythus, nobis.

*Form* : bill less gross sharper, the mandibles nearly equal and nearly intire : culmen and rictus arcuated : a salient tomial angle near the middle of the *lower* mandible : sometimes wanting ; wings shorter, scarcely exceeding the base of the tail : 3 and 4 quills longest and equal.

Tail even inclining to divaricate : tarsi smoother : toes shorter and more depressed ; lateral toes equal ; the anteriors basally, though trivially connected : nares more approximated, sunk, subvertical, opened centrally in the transverse lunated fosse, hid.

*Colour of the Male* : brilliant scarlet, with black remiges and rectrices broadly edged with scarlet : large coverts of the wings, black with scarlet edge and tip : tibial plumes black : under tail coverts dashed with dusky : bill, yellow ; legs, fleshy brown : iris, hoary brown.

Female : head, neck, upper back, wings and tail, dusky, broadly margined all round, or in the remiges and rectrices, on the outer vane, with dull greenish yellow : quills and tail blackish internally : rump bright yellow : breast and body below, dirty white picked out largely with dusky, sometimes in the form of subterminal cross bars : bill, legs and iris, as in the male, but duller. Size of the male,  $7\frac{1}{2}$  inches by  $12\frac{1}{4}$ , and  $1\frac{3}{4}$  oz. in weight. Female, rather smaller.

*Species 2nd.* SUBHIMACHALUS, Subhimalayan Finch, nobis.

Form differing somewhat from the last : the bill more pyrrhuline ; the anterior toes slenderer with unequal laterals, and straighter and more acute nails : wings with 3rd quill usually longest.

*Colour of the Male* : brilliant roseate red, largely picked out, with blackish on the top of the head, dorsal neck, and upper back : quills and tail feathers blackish, with broad roseate edges on the outer vanes. Breast and body below, plumbeous grey : bill and legs, brown flesh-colour, with a rosy tinge : iris, brown. Female : forehead and a large gorget on the top of the breast, bright yellow : rest of the head, the whole neck, and body below, plumbeous : the vent and under tail coverts, paler and albescent : body above, dull greenish yellow, picked out on the upper back with dusky : wings and tail dusky black, with greenish yellow edges to the outer webs : bill, legs and iris, as in the male, but duller. Size of the male,  $8\frac{1}{4}$  inches by  $12\frac{1}{2}$  ; wt.  $1\frac{3}{4}$  oz : of female, something less. Habitat ; the northern region : in winter, found in the central.

**Remark.** I have classed the two above species with *Corythus* because the expert at home seen to consider them as of that genus, and because till the generic characters of the whole of *Coccothraustinae* vel *Loxianæ* have been revised, they may as well be *Corythi* as anything else.\* Their fore toes, however, are not wholly cleft; nor their tails, properly speaking, forked; nor their wings longer than in *Pyrrhula*.

*Family* COCCOTHRAUSTINÆ, *genus* new, MUNIA, nobis,

**Character.** Bill as gross as in *Coccothraustes*, with the ridge line sub-arched; the mandibles equal, pointed and entire; upper mandible flattened on the ridge towards the base and spread like a plate over the forehead. Gape strongly angulated but without salient process in either mandible.

Nares round, vertical, sunk, free. Tarsi stout, scaled, longer than the central toes: toes long, slender, unequal compressed—outer fore basally connected—hind large: nails slender, acute and straightish. Wings short and feeble; primaries scarcely exceeding the tertiaries; 3 first quills subequal and longest. Tail medial, wedged and pointed.

*Species 1st.* M. RUBRONIGER, black and red Munia, nobis.

Head, neck, and breast, glossy black: centre of the belly, vent and under tail coverts, the same, but tinged with red: rest of the body and wings, pure cinnamon: rump darker, with lake tinge: rectrices brighter, with an orange chesnut hue: bill and legs soft plumbeous: iris black brown. Sexes exactly alike: young, brown, above; dirty rufous of a pale tinge, below; and the bill and legs darker and duller. Size of the species,  $4\frac{1}{2}$  to 5 inches by  $6\frac{1}{2}$  to 7, and weight  $\frac{1}{2}$  oz.

*Species 2nd.* M. ACUTICAUDA, sharp-tailed nobis.

Remarkable, even among its congeners, for the perfectly cuneate and acute form of the tail, just like a Woodpecker's but not rigid. Head, neck, breast, most part of the back, wings, rump, thighs and upper and under tail

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\* It appears to me not impossible that CUVIER would have considered the two first described species as *Corythi*, and these two as *Coccothraustes*! *Subhemachalus* inclines much to *Pyrrhula*; and none of the four species are typical. Hence the difficulty in classing them.

coverts, saturate rich brown, with whitish shafts to each plume : lower back and body below, white with narrow hastate marks on each plume of a dusky hue : lining of wings and inner edge of the quills towards their bases, immaculate buff : tail pure black : bill and legs, slaty blue ; pure and plumbeous in lower mandible of bill : iris brown : sexes alike : size of the last.

*Species 3rd.* M. LINEOVENTER, bar bellied, nobis.

Head, neck, body above, wings and tail, ruddy brown—more saturate on the head and neck ; and paled nearly to whity brown on the rump and tail : breast and belly white with frequent zigzag cross bars of black : vent and under tail coverts, whitish and unmarked : bills and legs, plumbeous : iris red : sexes alike : size of the two last.

Remarks. These singular little birds cannot with propriety be ranged under the genus *Coccothraustes*, nor yet under that of *Ploceus* ; for, as CUVIER, the institutor of the latter genus, justly affirms, the *Plocei* are distinguished by the straightness of the commissure of their bills.\* But the fact is, CUVIER's subgeneric characters are too vague to be of much practical utility ; and the specific descriptions of most general works so summary as to be nearly worthless.

If species are worth describing and transcribing, they should be described and transcribed adequately ; and if genera and subgenera are to be characterised by three words, families and subfamilies should *first* be more fully and exactly defined, the former characters being always understood with strict reference to the latter. Amongst the thick-billed Finches, there are some observable differences of structure both in the osseous frame work of the body and in the chylopoetic viscera—differences which, taken in conjunction with those of the whole external organs, might serve to separate these birds much more naturally than has yet been done ; especially if the indications

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\* *Báyá* is a typhical Indian species of *Ploceus*, common in the *taráí* but never seen in the Hills. *Coccothraustes* belongs to the cold regions : *Ploceus* to the hot ; *Múnia* is intermediate.

of internal structure (in the larger divisions) were eked out by those of *habit* and *manner*. But to return:—*Munia*, the name we have assigned to our new genus, is well known to the *tarāi* and to the Hills as the generic appellation of several species of tiny gross-bills, distinguished for their familiarity with man, their gregarious habits, their depredations upon the rice crops, and their ingenious nests.

The species are solitary in regard to nidification; but, *after* the breeding season they are all gregarious in a greater or less degree. They are exclusively graminivorous, feeding on hard grass, seeds or cerealia, according as one or the other are procurable; and they fix their large globular nests either among the spiny leaves of the palm trees or the thick interlaced branches of the lesser bamboos.

But there is no weaving or sewing employed in the structure of the nest. It is merely a large ball, laid against or upon naturally blended branches or stiff leaves, and having a small round entrance either on the side or at top. The eggs are many, and in *Rubroniger* of a bluish white colour. These birds are easily tamed and caged, but they have no song.

The whole three species are migratory, appearing in June and departing in November. Many of them breed in the Residency grounds, and solitarily so far as I have observed. The nest is composed of grass fibres, or leaves of the *Pinus Longifolia*, and is usually constructed in the midst of the small Chinese bamboo or of the dog-rose. The male and female labour at the work with equal assiduity, and share equally the task of rearing the young. In winter and spring they resort to the lower region, returning to us to breed just as the rains set in, and departing with their young so soon as the rice crop has been got in; after which the open cultivated country is perfectly bare for some months.

· PYRRHULINÆ. Genus PYRRHULA.

1st species. P. NIPALENSIS, nobis.

Form as in *Erythrocephala*; but the bill grosser with the tomial line of its upper mandible less even, and the tail still more conspicuously

forked and gradated. Colour and size—male, brown-smeared slaty blue, (like common slate stone) with black rump, wings and tails all reflecting a brilliant purplish blue gloss; cap picked out with dusky, and a band of the same hue round the base of the bill; a white spot under the eye; band across the rump, lower belly, vent, and under tail coverts white; outer web of the last tertiaries fiery red; bill greenish horn, with black tip; legs fleshy brown; iris brown;  $8\frac{1}{2}$  to 9 inches long by 10 to 11 wide, and  $1\frac{1}{2}$  to  $1\frac{1}{2}$  oz. in weight.

Female rather less, exactly like the male, save only that the outer web of the last quill towards the body is invariably yellow, and not fiery red as in the male. The young, at first, want this distinctive sexual mark. Habitat northern and central regions.

PYRRHULA? EPAULETTA. Epauletted Pyrrhula, nobis.

Form somewhat anomalous, uniting the wings, tail and feet of *Fringilla* with the bill of *Pyrrhula*. Bill strictly *Pyrrhuline*, but rather longer and less gibbous than in *Vulgaris*, with a sharp tooth on the tomial margin of the *lower* mandible, near its base; wings scarcely exceeding the base of the tail, 3 and 4 sub-equal and longest; 1 and 2 distinctly gradated. Tail medial, firm, even; the quills divaricating and pointed at their tips; tarsi rather elevante and nearly smooth: toes medial, compressed; laterals and hind sub-equal; outer fore connected to the joint: nails acute. Colour and size. Male—black with the occiput bright silken yellow: a ruddy yellow tuft at the bend of the wings (unde nomen); the tertiaries white, partially or wholly, on the inner web; vent more or less concolorous with the epaulettes; bill black; legs fleshy gray; iris brown; size  $6\frac{1}{4}$  inches by 9, and  $\frac{3}{4}$  oz.

Female, of the size of the male: top of the head and ears greenish yellow; dorsal neck and top of the back dull slaty blue; rest of the body, with the wing coverts and tertiaries, ruddy brown; remiges and rectrices dusky black: tertiaries whitened on the inner web, as in the male; and bill, legs and iris, colored like his. Habitat the northern and central regions: shy, adhering to the forests.

CARDUELINÆ. *Genus* CARDUELIS.*Species new.* C. NIPALENSIS, nobis.

Form of the bill as in *Carduelis Caniceps* and in the common Goldfinch: but the tarsi higher, and wings and tail apparently longer and stronger; wings to the middle of the tail, decidedly acuminate with the 3rd quill clearly longest; rectrices strong, broad, divaricating, acutely pointed; the whole slightly gradated from above, and the tail consequently, distinctly though trivially forked; tarsi elevate, finely scaled; toes long, slender, and compressed, with slender and very acute nails.

Colour and size of the male:—above, and the neck and breast entirely sooty black, or dusky strongly tinted with a dark sanguineous blossom red; forehead, a line over the eye to the occiput, the chin and throat, breast and belly, pure blossom red; under tail coverts paler and picked out with dusky; remiges and rectrices pure sooty brown, more or less touched on the outer margins with the red hue of the upper surface; bill and legs fleshy brown; iris red brown: size  $6\frac{1}{2}$  to 7 inches by  $10\frac{1}{2}$  to 11, and  $\frac{3}{4}$  oz.

Female rather less above olive brown; below, from chin to breast, dirty yellowish; from breast to tail, white; wings and tail dusky brown; the coverts of the former, with the tertiaries, externally margined or tipped with dirty yellowish; bill, legs and iris, as in the male but obscurer. Habitat central and northern regions.

ALAUDINO, *Genus* EMBERIZA.*Species New.* NIPALENSIS, nobis.

Form, typical in the main: \* bill elongate-conic, compressed, intire; culmen raised and subcarinated between the nares which are oval, lateral, shaded above and behind by membrane, and hid by tiny hairs; wings rather short; 3, 4 equal and longest; 1 and 2 distinctly gradated; tail even; tarsi and toes simple, ambulatory.

Colour and size. Male—blue glossed black with cinnamoneous wings and tail, which are both dusky towards the tips; tail-coverts mixed black

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\* That is, with the gape strongly angulated and the palate furnished with a large obtuse knob.



and cinnamon ; tertiaries darkened on the inner web ; forehead furnished with an elongated, slender, mobile, crest ; bill and legs fleshy brown ; iris dark brown :  $6\frac{1}{2}$  inches by 10, and 1 oz in weight.

Female has the crest smaller and the bill and feet duller hued : above she is dusky brown edged with grey ; below, rufescent white, streaked lengthwise with dusky ; quills and tail feathers dusky-brown, more or less edged externally with dull cinnamon, and showing that hue internally and basally on the quills almost as clearly as in the male : size nearly equal to his. The species is gregarious in small flocks ; feeds on small hard seeds and grains solely, and chiefly frequents the hedge rows and brushwood of the upland downs and meadows. In Winter, common in the central region : in Summer, resorts to the northern.

*Genus new.* FRINGALANDA, Lark Finch, nobis.

Bill as in *Fringilla* but smaller ; perfectly conic, intire, straight and pointed ; tomice of the lower mandible inflexed and scarp towards the gape, but without angulation or salient process ; palate well scooped out and smooth ; wings very long, passing the center of the tail ; 2nd longest ; 1st and 3rd subequal ; tertiaries truncated and square ; much short of primaries ; tail longish, firm, slightly but distinctly forked.

Tarsi submedial, finely scaled ; toes compressed and slender ; the laterals and hind subequal ; outer connected to the joint.

Nails long, slender, acute, straightish ; hind largest, less the toe.

Nares oval, lateral, shaded above by membrane and hid by small hairs.

*Species new.* F. NEMORICOLA. Forest-haunting Lark Finch, nobis.

Form has been detailed above.

Colour and size :—above dusky brown, edged with rufous, as in so many of the Larks ; below, sordid earthly grey ; or grey brown, paler as you descend the body ; long tail coverts, above blackish with white tips, below, white with dusky centres ; remiges and rectrices dusky ; the long wing coverts and the tertiaries, with broad edging of rufous or white colour ; bill and legs fleshy brown ; iris red brown ; sexes exactly alike : size  $6\frac{1}{2}$  by  $11\frac{1}{2}$ , and 1 ounce in weight.

**Remarks.** These birds are confined to the central and northern regions, and never quit the skirts of the forest. Their habits are very like those of the arboreal Larks, but they never come into the open country. Their stomach is a powerful gizzard; and their food, kernels and hard seeds, which they digest by means of trituration with gravel. They seem to me eminently singular birds, and I regret I do not know more of their manners. They have sundry points of contact with the genus *Plectrophanes*; but are separated essentially therefrom by their smooth hollow palate; as noted in the generic character expressly to prevent such confusion.

The following detail of the dimensions of a fine male may help a just conception of the characters of the genus :

	<i>Inches.</i>
Tip bill to tip tail, .....	$6\frac{1}{2}$
Bill, length of, .....	$0\frac{8}{16}$
—, basal height of, .....	$0\frac{5}{16}$
—, ditto breadth of, .....	$0\frac{4}{15}$
Tail, .....	$2\frac{3}{4}$
Expanse of wings, .....	$11\frac{1}{2}$
Tarsus, .....	$0\frac{1}{16}$
Central Toe, .....	$0\frac{9}{16}$
Hind toe, .....	$0\frac{1}{16}$
Nail, .....	$0\frac{5}{16}$
A closed wing, .....	$3\frac{3}{4}$
Weight, .....	1 oz.

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### III.—NEW GENERA OF THE COLUMBIDÆ.

The Pigeons are usually and usefully divided into the terrestrial, the arboreal and the ordinary; the last uniting the attributes of the other two, and being the most perfectly organised of the family. The above form the genera *Goura*, *Vinago* and *Columba*; and, though I am aware that there

are other genera recently instituted, such as *Ptilinopus*, *Peristera* and *Ectopistes*, it will not be necessary for me to take more notice of them on the present occasion than by this mere allusion, made only to show that I have not overlooked them.

The remarkable bird which I am now about to introduce to the notice of Zoologists, unites the bill and wings of *Goura* with the feet of *Vinago*. This, as its general description, is strictly accurate; and therefore I presume it will be allowed that the species could not be introduced without violence into any existing genus.\* I shall therefore consider it as the type of a new one, to be reduced to a sub-genus, or wholly rejected, according to the discretion of the learned. All persons must allow with Mr. SWAINSON that this manner of introducing new species, at least insures an unusually accurate acquaintance with them *as species*. For the rest, until it has been decided, whether the Pigeons constitute an order, a family, or a genus, I suppose we may not look for very intelligible (so called) generic characters. As to the objection to a genus founded on one species, it appears to me that any person who carefully distinguishes a striking modification of form, may reasonably anticipate that *very many recorded* species will be found to belong to it, so soon as our knowledge of the (in this case) vast and promiscuous heap of them, comes to exceed a faint notion of their mere colours and size.

*Sub-family*.—VINAGINÆ OR TREE PIGEONS.

*Genus or Sub-genus*—DUCULA *nobis*.—DUKUL OF THE NIPALESE. (genericé)

Character of the genus :—bill equal to the head, straight, cylindric, very feeble; both mandibles membranous for three-fourths from the gape; tip of the upper mandible gently inclined—of the lower, strongly compressed; nares broad, linear, obliquely transverse, central; their groove faint; their tect subtumid.

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\* If the *Columbidæ* be regarded as a family, divided into the three sub-families *Gourina*, *Vinagina*, and *Columbina*, I place this bird at the entrance of the second from the first of these sub-families.

Wings short, not rounded, 3, 4, 5 quills sub-equal and longest ; central primaries with their tips wavily truncated.

Tail 14, long, strong and square ; tarsi very low,\* and plumed nearly to the toes laterally, less in front ; toes depressed with broad flat soles ;\* lateral toes sub-equal, hind large ; nails strong, arched and acuminate ;\* central and hind equal, lateral toes equal, less ; orbits nude ; plumage simple. The above is a tedious character, but it is a distinct one. Those who love more summary proceedings may perhaps approve the following :

“ Bill and wings as in *Goura* ; legs and feet as in *Vinago*.” But the fact is that the bill of our bird, nearly as it resembles that of *Goura*, is clearly distinguishable therefrom, by less compression, a fainter grooving, and a more tumid nasal tect. The wings, again, with the same general character, are strikingly marked by the singular truncate angulation or curve at the points of the central primaries.

In like manner, the feet, though exclusively adapted for perching, and consequently framed strictly upon the model of the same organs in *Vinago*,† (and *Plitinopus*), differ therefrom by the subequality of the lateral fore toes, and by the absence of that extreme and sudden acumination of the nails which distinguishes them in that genus. The wings of our birds differ entirely from those of *Vinago* ; the latter being longer, conspicuously acuminate, with sharp narrow primaries (3) analogous to those of the lesser Indian Bustard. In our bird there is no acumination of the wings : the

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\* These characters, I admit, belong rather to the sub-family than to any genus or sub-genus of it (see note in the sequel) : but, so long as the sub-family continues to be vaguely defined, its genera must be defined diffusely. On this principle I *might* add, that the toes of our genus are cleft : but the fact is, this is a character co-extensive with the whole family ; and reiteration must have *some* limits.

† It is a strange misinterpretation of the language of CUVIER, (I suppose,) which led STEVENS to assign toes connected by membrane to *Vinago*. They are cleft though *bordered* ; that is, the edges are spread laterally by the depression of the soles. There is something so decided and necessarily influential in the exclusively perching feet of the *Vinaginæ*, that I consider this character the diagnosis of the sub-family ; and I class our bird with the *Vinaginæ*, notwithstanding the extreme feebleness of its bill, *because* its feet are utterly unsuited to walking.

webs of all the quills are broad: and the peculiarity of structure is confined to the points and begins with the 3rd or 4th primary, extending thence as far as the secondaries. In *Vinago*, too, the membranous and soft part of the bill scarcely reaches forward to its centre, the organ having double the strength which it possesses in our bird. In *Vinago*, the tumid tect of the nares is nearly evanescent: in our bird it is distinct, though less conspicuous than in the Pigeons proper. Lastly, though *Ducula*, like *Vinago*, be exclusively arboreal and fruit-eating; the latter is eminently gregarious—the former, almost a solitary.

*Species new.* DUCULA INSIGNIS. Great Ducula, nobis.

Habitat central and lower hilly regions.

*Colour and size*:—head, neck, body below, and lining of the wings, soft blue grey or grey blue; paler and albescent on the chin, and richly tinted with vinous on the back of the head and of the neck; lower tail coverts, soft buff; quills and tail slaty black; terminal 1-3rd of the latter, and lower back, slaty blue; upper back, shoulders, and wing-coverts, saturate slaty, internally, but merged in a brilliant vinous hue on the whole surface; bill and legs intense sanguine; terminal hard portion of the former, and the nails, dusky horn; orbit skin slaty, merging in purple; iris hoary or blue grey: 20 inches long by 30 wide:  $1\frac{1}{2}$  lbs. in weight.

Female, a-fourth less than her mate; wants almost wholly the rich vinous tint of the male; and is, generally, more obscurely coloured.

The following are the dimensions of a fine male :—

	<i>Ft. Inches.</i>	
Tip bill to tip tail, .....	1	8
Bill, .....	0,	$1\frac{1}{2}$
Tail, .....	0	8
Expanse of wings, ....	2	6
Tarsus, .....	0	$1\frac{5}{8}$
Central toe, .....	0	$1\frac{7}{8}$
Outer fore toe,.....	0	1
Inner ditto, .....	0	$0\frac{1}{2}\frac{5}{8}$
Hind ditto, .....	0	$0\frac{1}{2}\frac{5}{8}$
Weight, .....	1 lb.	$8\frac{1}{2}$ oz.

[For sketch of the foot and bill see accompanying plate.]

*Genus or Sub-genus*—TORIA nobis.—THORYA. (quasi Rostratus) of the  
Nipalese Character.

Bill shorter than the head, compressed very strong with the tip heavily bent and membrane at the base nearly obsolete; nares longitudinal, linear, simple;\* wings sub-medial; 2d longest, 3d lunately emarginated on the inner web; the rest simple;† tail 14, short, even; orbits and lores nude; tarsi equal to the central toe, nude; knccs clad; acrotarsial scales nearly perfect; paratarsus smooth.

Toes unequal; the two exterior fores compressed and slender; the inner fore and hind somewhat depressed and bordered; hind stout; outer toe longer than the inner; nails falcate and acute; hind largest; plumage simple. If the bird previously described appeared to be placed on the confines of the arboreal and ground Pigeons, belonging to the former, so this seems to possess a similarly-osculant character. Its aberration, however, from the sub-family type consists chiefly in the structure of its feet; not in that of its bill as in the preceding genus.

Its wings are longer than in *Goura*, shorter than in *Columba* or *Vinago*. The quills offer no peculiarity save that noted above, and the firm primaries exceed the tertiaries by  $1\frac{1}{2}$  inch. The bill possesses more strength and a stronger bend than in any species of the whole family I ever met with. The nares longitudinally developed, and neither fossed nor provided with a tumid tect, are quite unique. The feet have, upon the whole, a perching character; but they are, at the same time, by no means so utterly unsuited for walking as those of the typical arboreal Pigeons. With reference to the doubtful attributes of the feet and wings of our bird I have been induced to range it with hesitation amongst the *Vinaginæ* owing to the extreme power of the bill—certainly a decided, though not, I think, the most decided character of that sub-family. The habits of the species are very similar to those

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\* Nares simple, that is, neither fossed as in *Goura*, not swollenly membraned as in *Columba*, and in a less degree, in *Vinago* also.

† 2, 3, 4 are slightly sinuated on the outer web; but the mark is too common to be characteristic.

of the small ordinary Doves. It is however, much rarer and more shy than any of them. It is not very gregarious ; adheres to the forests ; feeds chiefly on soft fruits, and prefers the trees to the ground ; but without absolute exclusiveness of habit in that respect. Its habitat is the central and lower hilly regions.

*Species new*, TORIA NIPALENSIS, Nipalese Toria, nobis.

*Colour and Size.* Top of the head plumbeous ; cheeks, with the entire neck and body below, lower back, upper tail coverts and central rectrices, medial grass green, paler and yellower below than above ; thighs, vent, and lateral inferior tail coverts picked out or tipped with white ; rest of the inferior tail coverts deep buff : upper coverts of the wings, top of the back and scapulars, rich maroon red ; wings black ; the great coverts and tertiarics, broadly tipped and margined on the outer side with brilliant yellow ; rectrices, except the 4 central ones, plumbeous above, with a sub-terminal dusky bar ; below, paler especially at the tips ; lining of the wings, and the quills on the lower surface, plumbeous ; base of the bill and the legs deep sanguine ; bill before the nares and the nails bluish yellow horn colour ; outer circle of the iris orange red, inner circle blue ; orbital skin bright green.

The female is nearly of the same size, but she wants the rich maroon mantle of the male, being green on the upper back ; and her inferior tail coverts are all green, picked out with white, like the thigh coverts : size, 10 to 11 inches by 16 to 17, and weight 6 to 7 oz.

The full dimensions of a fine male are as follows:—

	Feet.	Inches.
Tip bill to tip tail, .....	0	10 $\frac{1}{2}$
Bill, .....	0	0 $\frac{7}{8}$
Tail, .....	0	2 $\frac{1}{8}$
Expansion of wings, .....	1	5
Tarsus, .....	0	1
Centre toe, .....	0	0 $\frac{1}{2}$
Outer, .....	0	0 $\frac{1}{2}$
Inner, .....	0	0 $\frac{1}{2}$
Hind, .....	0	0 $\frac{8}{8}$
Weight, .....		6 $\frac{1}{2}$ oz.

[For sketch of the bill and foot see accompanying plate.]

## IV.—NEW GENUS AND 3 NEW SPECIES OF THE SILVIADÆ.

SYLVIADÆ. Genus new, YUHINA, nobis; *Yuhin* of the Nipalese.

Bill equal to the head, slender, acute, depressed as far as the nares, gradually compressed beyond; maxilla cut out to centre by nasal fossæ, convex beyond, subarcuated throughout, and gently inclined at tip, with 2 or 3 sharp teeth on either side; mandibula straight, equal to maxilla, pointed; toniæ of both, trenchant, erect, scarpèd and locked throughout; nares large, the aperture lunated and lineated by a nude, incumbent, soft, membrane.

Tongue subequal to bill, cartilaginous, deeply forked, and the prongs filamentous and convolved; wings sub-medial, round-acuminate, firm; 1st quill small, 5th usually longest; tail short, firm, square; tarsi stout, finely scaled, longer than any toe; toes simple; exterior connected to the joint; laterals and hind subequal; last very stout and depressed: nails falcate, acute; anteriors subequal; hind much the largest; head crested; rictus slightly bristled.\*

Habitat, central and northern regions. Food, viscid stony berries and small scaly insects, such as harbour among foliage. It is the opinion of Mr. VIGORS that these singular little birds serve to connect the *Silviadæ* with the *Certhiadæ*. In the structure of the bill and tongue, and even of the feet and wings, they remind me of the genus *Sibia* (nobis) and of others of the Philedonian Thrushes of CUVIER—a group the contents of which have been referred at random to the Tenuirostral *Meliphagidæ*, and (in part at least) to the long-legged division of the Thrushes. These are high matters of classification, which may perchance be settled with an approach to accuracy some 50 years hence, provided our investigations meanwhile be carried into the general structure and prevalent habits of species,—and be not confined, as now, to closet dissertations on dried skins.

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\* If family and sub-family characters had the requisite precision, and our genus could be now safely referred to a given family and sub-family, half of the tedious particulars of the generic character might have been omitted, as they will be hereafter.



The genus I now propose, as well as its location, are both provisional—my knowledge of the structure and habits of the species being confessedly incomplete ; and the directions of the books within my reach being better calculated to misguide than to guide.

These little birds, so far as I have yet ascertained, adhere exclusively to the great forests : prefer the lower and more umbrageous to the higher and barer trees ; and seem to procure no portion of their food from the ground though their feet are sufficiently adapted for walking. They are usually found in small flocks ; and have a monotonous feeble monosyllabic note.

Their intestines are about the length of their body (from the tip of the bill to the tip of the tail) furnished with grain-like cæca, near the lower end, and of nearly uniform diameter. Their stomach has the muscular coat of very moderate, subequal, thickness, and the lining is neither very tough nor much grooved.

Three species are known to me, in all of which the sexes resemble each other. I now proceed to a summary description of them, premising that the two first are typical—the last, much less so.

*Species 1st.* YUHINA GULARIS ; Spotted Throated Yuhin, nobis.

Above, with the tertiaries and tail feathers, obscure olive brown ; cap, darker and purer brown ; ears, chin, throat and breast obscure rufous wood brown ; the chin and throat spotted blackish, and bounded laterally by a longitudinal stripe of the same hue ; rest of body below, bright orange-rusty ; primaries and secondaries black, the former with a narrow edging of hoary, and the latter, with a broad one of orange ; lining of the wings and inner margin of the quills towards their bases, albescent ; tail dusky internally ; legs deep orange ; bill fleshy brown with dusky culmen ; iris brown ; head with a full soft mobile and subrecurved crest : size  $6\frac{1}{2}$  by  $8\frac{3}{4}$  inches and  $\frac{3}{4}$  oz : bill,  $1\frac{1}{6}$  inch ; tarsus  $\frac{1}{16}$  ; central toe  $\frac{5}{16}$  ; hind toe  $\frac{5}{16}$ .

*Species 2d.* YUHINA OCCIPITALES ; Rusty-naped Yuhin, nobis.

Above with the whole tertiaries and outer webs of the larger remiges and of all the rectrices, dull obscure olive brown ; top of the head and back of neck dull slaty with hoary stripes ; the nape bright rusty ; ears, chin,

abdominal neck and the breast vinous buff, a blackish stripe like a moustache behind the gape; belly, rump and under tail coverts deep rusty; remiges and rectrices internally dusky; inner basal margins of the quills pale buff; lining of wings white; legs orange; bill fleshy red; iris brown; head with a full soft crest, as in the preceding: size  $5\frac{1}{2}$  by  $7\frac{1}{2}$  inches and  $\frac{1}{2}$  oz. in weight; bill  $\frac{10}{16}$  inch; tarsus  $\frac{11}{16}$ ; central toe  $\frac{7}{16}$ ; hind  $\frac{5}{16}$ .

*Species 3d.* YUHINA? FLAVICOLLIS; Yellow-necked Yuhin, nobis.

Above obscure brown, with a slaty tinge; cap pure rich brown; cheeks and nape paler; back of the neck rusty yellow, continued in a collar round the sides and front of the neck, and thence spread over the lower surface of the body and diluted often to white; chin and throat white; moustache dark brown; remiges and rectrices internally dusky; the primaries edged externally with white on the outer webs, and all paled internally on the inner, as in both the preceding species; lining of wings white; sides of body shaded with brownish; legs yellowish fleshy grey; bill fleshy brown; iris brown; head crested as in both the preceding species; bill shorter, less acuminate, and furnished with only one salient process on each side the tip of the upper mandible of the bill: size  $5\frac{1}{2}$  by  $7\frac{1}{4}$  inches, and less than  $\frac{1}{2}$  an oz. in weight.

The following is a detail of the dimensions of a fine male specimen of *Yuhina Gularis*, and which may serve to indicate the proportions of all the three species:

	Inches.	Frac.
Tip bill to tip tail, .....	0	$\frac{1}{2}$
Bill length of, .....	0	$\frac{11}{16}$
— basal height of, .....	0	$\frac{3}{16}$
— ditto breadth of, .....	0	$\frac{5}{16}$
Tail, .....	2	$\frac{1}{2}$
Expanse of wings, .....	8	$\frac{3}{4}$
Tarsus, .....	0	$\frac{11}{16}$
Central toe, .....	0	$\frac{8}{16}$
and nail, .....	0	$\frac{3}{16}$
Hind toe, .....	0	$\frac{6}{16}$
and nail, .....	0	$\frac{5}{16}$
Weight, .....	$\frac{3}{4}$	oz.

[For sketch of the bill and foot see plate.]

## V.—NEW SPECIES OF THE STRIGINE FAMILY.

*Genus* ULULA? *Species* new, NEWARENSIS, Newár\* Owl, nobis.

*Form.* Bill shorter than the head, but of considerable length and somewhat straightened towards the base, moderately compressed, strong, at base as high as broad; tomice, plane and scarcely locked; tip of the lower mandible notched and truncated.

Nares large, ovoid, sub-transverse, opened chiefly towards the front and placed high on anteaal edge of the cere which is somewhat tumid and soft behind them, though far less so than in *Noctua*. Cere rather large and, as well as the nares, concealed by bristles. Disc medial, complete, decidedly less than in *Otus*. Corch medial, elliptic valved, with the auditory canal opened basally. Tarsi and toes medial, longer than in *Bubo*, moderately stout, thickly plumed with one or two scales next each talon. Talons acute, moderately unequal, somewhat squared and channelled below, inner fore and central equal; hind least. Tail longish, squared, firm, sub-bowed. Wings medial,  $2\frac{1}{2}$  to 3 inches less the tail; 5 and 6 quills longest and equal; 4 first considerably and sub-equally gradated; 1st  $3\frac{3}{4}$  inches less the longest; all the great quills considerably emarginated remotely from their tips and on both webs, save the 1st which has the outer web entire. Outer webs of all these quills more or less pectinated; of the 1st entirely so. Scapulars five inches, and tertiaries two inches, shorter than the longest primary. Egrets none.

*Colour and Size.* Head, dorsal neck, outer soft zone of the disc, back, scapulars, and wing coverts, saturate rich brown and immaculate; remiges and rectrices the same, but crossed by many (10 to 12) narrow bars of a whity-brown hue, and the tips of both slightly but clearly blanched. Entire body below, as well as the legs and feet, the lining of the wings, the disc

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\* Name of the indigenous people of Nepal proper.

and the inner and concealed scapulary feathers, pale sordid rusty, with very many (12 to 14 per plume) transverse narrow bands of a bright brown, darkened on the lower edge; brows rufous-hoary; margin round the eye and space between eyes and nostrils black, a white transverse zone on the throat below the disc; breast darker than the body; quills internally towards their bases, bright buff and many of the upper wing coverts, barred internally; iris dark brown; bill bluish towards base; greenish horn yellow towards tip; talons horn grey with blackish tips: 20 to 21 inches by 48 to 50 between the wings. Weight  $2\frac{1}{2}$  to  $2\frac{3}{4}$  lbs. Sexes alike both as to size and colours.

*Remark.* These birds are entirely nocturnal: they tenant the interior of woods and never approach houses. They are commonest in the central region—rare in the northern—unknown to the southern.

In the present state of Strigine classification it is impossible to say to what genus or subgenus our birds should be referred. They may be *Nyctæ*, or *Ululæ*, or a *tertium quid*: and at all events, the bill is neither short nor arched from the base, as (for example) in *Otus*, in *Scops*, and in *Noctua*. I have set them down in my note book as the type of a new genus or subgenus under the Newar generic title of *Bulaca*, with the more significant of the characters above given in detail.

*Genus* BUBO? *Species* new. CAVEARIUS nobis.—Hole-haunting Owl nobis.

*Form.* Bill and nostrils as in the last. Disc smaller and incomplete over the eye, but still of considerable size. Opening of the ears ovoid, not valved, smaller rather than in the last, but still large: the auditory canal opened subcentrally on the postear side and crossed by a membranous band couch,  $1\frac{3}{16}$  inch long. Feet as in the last, but the tarsi rather higher and slenderer, and the talons not channeled below, but merely squared. Wings longer and less gradated;  $1\frac{1}{2}$  to 2 inches less the tail; tertiaries and scapulars both long, subequal, and falling within 2 inches of the ends of the great primaries; the latter not bowed though soft and broad webbed; 3d and 4th quills subequal and longest; 1st, scarcely  $1\frac{1}{2}$  inch less than the 3d,

which is usually the longest of all ; 3 first strongly emarginate on the inner web near the tips—on the outer webs entire or nearly so. Pecten of the outer web complete on the 1st quill—extending over only half of the second. Egrets large, consisting of 6 to 10 gradated plumes rising from the postea and superior angle of the orbits. Tail longish, not bowed, firm, very slightly rounded.

*Colour and size.* Brilliant rufous yellow, merging, as the ground colour, into deep brown upon the cap, shoulders, tertiaries and scapulars where the darker hue preponderates, mottled barwise and otherwise variegated by the paler colour. Neck, upper back and breast, broadly striped down the shafts with saturate brown ; downy plumage of the belly, vent, and thighs, immaculate ; long plumes falling over the belly, tibial tufts, and lining of the wings, minutely zigzagged crosswise with brown, there being 8 to 10 lines on each plume which frequently, owing to its dark shaft, exhibits the herring-bone marking : tarsi lunated with brown : toes immaculate : remiges and rectrices with 6 or 7 mottled bars—dark upon a pale ground in the prime quills and lateral tail feathers—pale upon a dark ground in the central caudal, and lesser wing, feathers ; disc concentrically rayed with brown lines, and zoned postea by black brown, counterminously with the limits of the external ear. Egrets brown like the cap, and picked out with that brilliant ruddy yellow which, amid all the transitions of the plumage, clearly constitutes the *ground colour* of it : iris golden : bill dusky : talons dusky horn : size 22 inches by 55 to 58 inches : weight  $3\frac{1}{2}$  lbs. : female somewhat larger : male somewhat darker : but both distinctions trivial.

*Remarks.* These birds, when disturbed, fly freely and strongly in the broad glare of day, as (by the way) *Otus Europæus* et *Brachyotus* do ; and though neither the former nor the latter be properly diurnal questers, yet they are alike distinguished by commencing operations long before dark, and by carrying them on in the open country. Our species have their habitation sometimes in a hole or burrow in a bank side, (in which they always breed) and sometimes their domicile consists merely of a perch upon

the stunted trees growing from rocky declivities. Our birds breed in March, and seem to be confined to the central and northern regions ; for I have never procured one from the southern tract. The young, as soon as fledged, resemble their parents ; and the brood consists invariably of two of them.

*Both* the preceding species have eminently medial characters, being alike remote from *Strix* and *Otus*, on the one hand, and from *Scops* and *Noctua* on the other.

The bill has neither the length nor straightness of *Strix*, nor the shortness and arcuation of *Otus*.\* In strength, it is greatly superior to the bill of the former genus—by no means inferior to that of the latter. It resembles generally the same organ in our *Cultrunguis*, but is shorter somewhat, and the base is more beset with bristles than in *Cultrunguis*.

Another noble bird, *Huhua Nipalensis*, presently to be noticed, carries the elongation and straightness of the bill, accompanied by great depth, breadth and power, to a yet further degree. So that we have here a complete new series of Strigine Birds, typifying in their own circle, the Aquiline sub-family of the *Falconidæ* ;—or, CUVIER'S assertion (followed without question by all other writers) that the genus *Strix* alone exhibits either elongation or straightness in the bill, is wholly unfounded.

The tarsi, toes and talons of both the preceding species are framed upon the Otine model ; whereas in our *Huhua Nipalensis*, there is a diminution of length with proportionate accession of power in the tarsi, analogous to the characteristic form in *Bubo*.†

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\* *Noctua* and *Scops* have a bill similar to that of *Otus* ; but their small round nares with a very swollen tect, sometimes even salient and tubular (in *Noctua* at least) are contradistinctive : so also their unplumed toes. The toes of *Noctua* agree with those of *Strix*, saving only the pecten of the central talon in the latter genus. The wings of both *Noctua* and *Scops* are usually short ; but those of the former are of a firmer texture ; as is, indeed, their whole plumage.

† In defining *Cultrunguis* I omitted to state the length and nervousness of the toes, which, with the extreme roughness of the soles, are characters almost as significant as the cultrated talons, and obviously subservient to the same end of clutching successfully the slippery bodies of fish.

In the form and size of the ear conch our two species just described exhibit two distinct links in the chain of passage from *Strix* and *Otus* to *Scops* and *Noctua*; so also in the medial length of their wings; though this latter character would seem to be, in the Strigine family, less important and influential than amongst the *Falconidæ*. Why else have *Strix* and *Otus* the true Falcon's wing in common, whilst the beaks of the two are diametrically opposite in character? In *Strix*, however, the wings considerably exceed the tail—in *Otus* are only equal, or scarcely superior to it in length. Is, then, *Strix* the representative of *Milvus*? and *Otus* of *Falco*? Or must not the long and feeble legs and toes of the former, added to its straight powerless beak and long wings, induce us rather to seek its analogue in the Buteonine genus *Circus*? Our *Huhua* and *Cultrunguis* are evidently representatives amongst the Strigidæ of the *Aquiline* branch of the diurnal Raptores; the latter being distinctly, the analogue of the fishing genera of this branch. To the same branch must be referred, analogically, the two species now described; and which, by the combined straightness and power of their beak would also appear to be types of new genera in their own family—*unless* there be something very unsound indeed, in the entire existing classification of the *Strigidæ*, which admits no straight-billed Owls but *Strix*—a genus as remarkable for the *feebleness*, as for the straightness, of its bill.

Genus *BUBO*. Species new. *NIPALENSIS* mihi.

This remarkable bird, the largest of the family yet discovered, is 28 to 30 inches long and 65 to 68 inches between the wings,\* with muscular power in the legs far exceeding that of the Eagles, and with talons capable of giving that power the utmost effect in the destruction of life.

It has most of the influential characters of the Genus *Bubo*, but differs strikingly therefrom by the comparative length and straightness of the bill, and also, perhaps by the partial nudity of the toes, and by wings more nearly equal to the tail as well as differently gradated. Should these differences seem to warrant the establishment of a new Genus or Subgenus,

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\* The bill is  $2\frac{1}{2}$  inches; the tarsus, 3; the central toe,  $2\frac{1}{2}$ ; inner talon (along the curve)  $2\frac{1}{2}$ .

I beg to propose for it the name *Huhua*, latinised from *Huhu*, which is the common appellative of all Strigine birds in Nepal. At present I mean to consider it as a species of *Bubo* and to name it specifically *Nipalensis*, it being found in all parts of the Kingdom.

It tenants the interior of umbrageous woods, and by reason of the feeble light penetrating them even at noon-day, it is enabled to quest subdiurnally in such situations. It preys on pheasants, hares, rats, snakes, and sometimes on the fawns of the *Ratwa* and *G'horal*. The sexes nearly resemble each other ; but the young every where, and the old too in the Northern region, are more blanched than in maturity. The bill is equal to the head, straightened beyond the cere, abruptly and largely hooked, very strong, and furnished with an accipitrine festoon ; its lower mandible deeply notched and vertically truncated at the tip ; the tomia, obtuse and free towards the gape—trenchant, deeply locked, and internally scarped, towards the point.

The nares are placed high up and near to the anteal edge of the cere ; their aperture a broad ellipse, simple, transverse, with an aspect obliquely to the front.

Wings  $1\frac{1}{2}$  to 2 inches less than the tail ; 5th quill longest ; 4th nearly equal to it ; the three first considerably and equally gradated ; 1st,  $3\frac{1}{2}$  to 4 inches less the longest ; the four first strongly emarginated on the inner web, and 2nd to 5th inclusive, on the outer web also, remotely from the tips ; primaries two inches and more longer than the tertiaries : the last, as well as the scapulars, long and firm. Pecten complete on the 1st quill—clearly traceable on 2nd, 3rd and 4th, below the emargination. Tail medial bowed, square ; the extreme laterals subgradate. Legs immensely stout, short, and plumed nearly to the talons : exterior fore toe antagonising with the others, but not reversile : outer four and central, subequal in length, but the former much the stouter : terminal third of all the toes, denuded of plumes and furnished with three or four heavy scales to each toe : remainder of the toes, hirsutely plumose. Talons, acute and large : inner fore



much the largest ; next the central ; then the outer fore and the hind, which are subequal ; all flat beneath, and the process of the inner edge of central, entire. Tongue fleshy and entire, Intestines 30 to 44 inches long ; very thick coated ; considerably wider above and gradually diminishing in diameter downwards : at 6 to 9 inches from anal end two cœcæ of from 4 to  $4\frac{1}{2}$  inches in length, each of them. Stomach spheroidal ; of considerable subequal thickness in the coats, which are two—an exterior thin one of muscular fibre, and a thicker one constituting the body of the stomach, of granular structure and gland like : the lining membrane, softish, sub-plicated, and easily separable. Head not small : facial disc, very small and incomplete : opening of the ears, very small, simple, elliptic ; 4 to 5 eighths of an inch long. Egrets 3 to  $3\frac{1}{2}$  inches long, composed of 15 to 20 plumes, rising from the postcal and upper angle of the orbits, erigible, usually drooped.

The following description exhibits the external aspect of this bird. Above, saturate brown transversely barred and emarginated with rich rufous yellow ; the bars and points of the greater feathers mottled with brown ; a clear longitudinal line of rufous yellow down the lower or anteal edge of the scapulars ; the disc hoary, more or less smeared with brown ; great wing and tail plumes apertly quadrannulated. Below white, buff smeared on the breast, sometimes all over, and each plume cordated or barred heartwise with saturate brown ; thighs lunated with the same. Bill and nude part of the toes full yellow ; edge of the eyelid yellow, dappled with brown ; talons horn yellow with dusky points, iris brown. I have in my note book provisionally characterised this bird, as the type of a new genus : thus—

Bill equal to the head, straightened beyond the cere, suddenly hooked, very strong, festooned ; wings medial, sub-equal to the tail ; 5th longest ; 3 first considerably gradated ; 1st pectinated. Legs, as in *Bubo* ; but the toes more hirsute and denuded, and the outer fore antagonising, not reversile.

Talons very unequal, large, and acute. Egrets as in *Bubo*. Disc and ears smaller. Tail medial, square.

To the above account of a bird which I fancy is the largest known species of the family, I shall add a brief description of another, that I suspect is the least.

*Genus* NOCTUA. *Species new*. NOCTUA TUBIGER. Tube-nostrilled  
Noctua, mihi.

Coloured exactly like *N. Cuculoides*, but with a buff patch, inclosing a black triangle, on either side the neck : nostrils furnished with prominent tubes and opened laterally at the ends of them. Length  $5\frac{1}{2}$  inches ; breadth 11 to  $11\frac{1}{2}$  ; weight  $1\frac{3}{4}$  oz. Such is the distinct specific character of this singular little bird, which would scarcely form a mouthful for its noble congener, just described.

*Genus* NOCTUA. *Species new* ; TARAYENSIS, nobis. *Tarai Noctua*, nobis.

Form and size as in the *Noctua Cuculoides*, of which species our bird is the palpable representative in its own region—the former being peculiar to the hills—the latter to the forest at their base. I notice this fact, because I have proof of the very same identity of form and size, with great diminution of intensity in the colour, in two species of *Accipiter*,\* which in like manner are exclusively confined to the lowlands and highlands respectively ; the dark bird being, in this instance also the mountaineer.

*Colour*. Above earthy grey brown, each plume exhibiting two white spots disposed opposite each other and barwise. Below white broadly barred or cordated barwise, with pale ruddy brown. Tarsi immaculate, tail with 3 or 4, and wings with 5 or 6, white bars ; disc white for the most part, confined by dark brown on the outer and soft zone ; but the ear coverts distinctly barred transversely or vertically ; iris straw yellow ; feet obscure yellow ; bill greenish horn.

*Genus* SCOPS of Savigny.† *Species new* ; SUNIA or golden Scops, nobis. *Sunya Cusyal* of Nepal.

\* *Accipiter Scutarius* and *Accipiter Affinis*, nobis.

† Apud SHAW XIII. 51, for CUVIER gives no egrets to this group, and does not specify the naked toes.

*Form.* Bill short and wholly arched; nares small, round, with a swollen softish tect, and hid, as well as nearly the whole bill by bristles; disc small and imperfect; but larger than in *Noctua*; conch of ears  $\frac{3}{8}$  of an inch long, very small, oval, simple, protected by a double cross row of setaceous plumes; egrets distinct and rather large; tarsi medial, plumed; toes longish, the inner and central ones sub-equal, all quite nude, reticulate with 3 or 4 scales next each talon; talons sub-equal, acute, the inner fore sub-pectinated or sub-cultrated below; grasp of the foot oblique; tail medial, soft, square, not bowed; wings longish, reaching within  $\frac{1}{2}$  to  $\frac{3}{4}$  inch of the end of the tail; 4th quill usually longest; 3 first moderately and sub-equally gradated up to it; scapulars and tertials long; most of the prime quills emarginated remotely from the tips, and their edges frayed or discomposed, but the first only distinctly pectinated; plumage characteristically soft, (a strong distinction as compared with *Noctua*); eye and head larger than in *Noctua*; lives in the interior of woods.

Habits nocturnal. *Colour and Size.* Above, with the whole head and neck, golden red, narrowly striped with black down the shafts of the plumes. Below, white, touched irregularly with the colour of the upper parts, and finely herring-boned with black; disc between the eye and bill often white, and its soft outer zone nearly black; outer edge of the scapulars, white with black lunules; quills and tail quadricinctate; the bands mottled and blackish; bill dusky; legs obscure fleshy grey, iris straw colour;  $7\frac{1}{2}$  to 8 inches long by 18 to 19 wide. Weight  $2\frac{1}{2}$  to 3 oz.; sexes alike; young, duller hued and vaguely marked.

*Species 2d.* LETTIA, nobis. The *Lattya Cusyal* of Nèpál.

*Form and Size.* As in the last and habits the same. *Colour.* Above a tawny medial brown, striped lengthwise, blotched and vermiculated ad infinitum with black; below rufous yellow, or rufescent white, herring-boned with blackish; tarsi transversely lunated or barred with the same; quills and tail with 6 to 8 mottled bands of buff upon a brown ground, or of brown upon a buff one; disc hoary or buff, vaguely lineated in circles with brown; egrets rather smaller than in the last, black variegated with buff;

legs fleshy grey ; bill blueish horn, iris variable, yellow in the young, brown in the old birds ; sexes alike. Habitat central and northern hills.

P. S. All the above species have the inner edge of the central talon produced like a comb, but without teeth. The mark is obviously too general to be significant except in *Strix* where it is toothed.

27th August.

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## VII.—TWO NEW SPECIES OF THE PARROT TRIBE.

PALEORNINA, Vigors *Genus*. PALÆORNIS? *Species* new ; NIPALENSIS, nobis.

*Form.* Bill large, very conspicuously arched along the ridge, at base much higher than long, moderately compressed with subconvex sides and broad round back. Tomial line of maxilla, untoothed and unfestooned : hook crenulated within. Mandibula rather short ; its tomial line unnotched and straight ; its tips strongly bent up and squared.

Cere, very small, entire, and, with the round nares, almost or quite hid. Wings long ; 2nd longest ; 3rd plus the first ; all three narrowed and sharpened towards their points. Tail very long, typical ; the two central plumes  $4\frac{1}{2}$  to 5 inches plus the rest. Feet as in *Paleornis*. Orbits plumose.

*Colour and Size.* Very brilliant green, somewhat shaded with verditer blue on the nape, belly and lining of the wings. Tail paler than the body and shaded externally with yellow ; below, and the tips and inner vanes, yellow ; throat and a broad half collar, black ; the collar completed dorsally with rosy red ; a large longitudinal bar of sanguine lake color down the shoulders, just outside of the scapulars : bill intense coral red ; iris pale straw ; legs greenish grey ; talons dusky, size large, 22 inches long by 26 wide, and 9 to 10 oz. in weight.

Female rather less, and without any red mark on the wing. Young, at first, wholly green with a yellowish bill. Inhabits the Saul Forest exclusively, and is not known to the Parrot-tamers.

*Remarks.* This species differs from *Paleornis* by a heavier and more entire bill, as well as by the narrowing and pointedness of the three prime quills, in the manner of *Vinago Militaris*

*2nd Species.* SCHISTICEPS slaty headed, nobis.

*Form.* Entirely typical, (*Palæornis*) except that I do not perceive any widening of the outer vanes of the 2d, 3d, and 4th quills towards their middle. The 1st is longer than the 3d ; the former being but  $\frac{1}{8}$ , and the latter above  $\frac{3}{8}$  of an inch less the 2d ; and all three have obtuse points. The central rectrices are  $3\frac{1}{2}$  to 4 inches longer than the next pair. The tomixæ are very scarpt, trenchant, and, as well as the hook, crenulated internally.

*Colour and Size.* Brilliant green, paler and flavescent below ; entire cap saturate slaty blue, confined below by a narrow band of black, which widens as it approaches the black throat ; two central rectrices green at the base, blue in the middle, and yellow at the points ; the rest, green on the outer vane, bright yellow on the inner, and at the tips ; wholly yellow on the inferior surface ; a narrow subtransverse dark blood bar on the shoulders. Bill, above, coral red ; its cutting edge, hook and the whole of the lower mandible, yellow. Iris, straw ; orbital skin, slaty ; legs, dusky green. Size, 15 to 16 inches long by 18 to 19 wide ; and  $4\frac{1}{2}$  oz. in weight.

Female rather less ; her tail less gradated ; no blood spot on her shoulders. Young, at first, wholly green, and taking the colours of maturity slowly and gradually.

*Remark.* This species inhabits the central, as well as lower, region ; and is constantly tamed.

The other Psitticine Birds of Nepal are, *Rodocephalus*, *Mystaceus* and *Alexandri* ; all belonging to the Genus *Palæornis* and confined, for the most part, to the lower region, where (by the way) the tiny *Latkan* is also found. *Mystaceus* is distinguished for the flatness of the ridge of its bill, and for the shortness of its tail. Two or three species have been manufactured out of this one.

*August 29th, 1836.*

## VIII.—NEW SPECIES OF POMATORHINUS, AND ITS ALLIES,

## WITH REMARKS ON THE GENUS.

Whoever will attempt to classify half a dozen of the familiar Sub-Himalayan species, known to the people themselves by the generic titles *Gáurá* and *Bhiácurá*, will be, I think, forcibly struck with the profound truth of the adage that, “Practise often creeps where Philosophy cannot soar.”

The people generalize and unite upon the strong ground of similar habits and manners, joined to a certain family likeness in external aspect; the Philosophers specialize and divide upon the feebleness of distinctive formation in the details of *some one or two external* organs. I admit the validity of the distinctions so far as they go, but I think they are, in these cases, more than counterbalanced by prevalent uniformity of *general* structure, and by *similarity of manners*; in other words, that the *Gáurás* and *Bhiácurás* constitute two, and but two distinct though closely allied\* genera, each exhibiting several subordinate but well defined modifications of form, or sub-genera. I have already remarked upon the general resemblance and particular differences of the *Gáurás* or *Cinclosomæ*. Upon those of the *Bhiácurás* or *Pomatorhini*, I shall now make a few observations.

The essential characters of *Pomatorhinus* appear to me to be as follows:

A bill considerably elongated and arched throughout, perfectly entire, slender, strong, obtuse, cylindrico-compressed, with broad convex ridges and plane vertical sides; its tomia somewhat scarpt and locked towards the centre of the bill, simply opposed towards the *solid* tips of both mandibles,

Short basal nares free from plumes, and closed above by a hard, arched, and porrect scale. Stout, ambulatory, sub-corvine legs and feet; and feeble

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\* Of this alliance it is a striking proof that one of my species (of *Timalia*) was marked by an eminent authority in England, as being “new and closely related to *Cinclosoma*.”—See Remarks in the Sequel.

bowed wings and tail—the former short and rounded—the latter more or less elongated and gradated on the sides.

*Timalia* and *Prinia* seem to be obviously sub-genera of *Pomatorhinus*, both distinguished from the generic type by a shorter and less arched bill, and by the rigid spinous character of the shafts of the plumage, more especially on the head and neck. In both sub-genera the legs and tail are rather longer, and the tarsi more heavily scaled than in the generic type. The last member or tail consists, in *Timalia*, of twelve rectrices, as in *Cinclosoma*. But in *Timalia* they are broader and more gradated to the sides; in *Prinia* narrower, 10 only in number, and strongly gradated throughout, with yet greater accession of length.

The most typical species of *Pomatorhinus* I consider to be *Erythro-genys Gouldii* (1831), *Ferrugilatus*, nobis. (MS. 1826.)

The following is a detail of its form and colours :

CRATEROPODINÆ. SW. POMATORHINUS. Horsf.

*Species 1st.* ERYTHROGENYS GOULDII.—FERRUGILATUS, or Rusty-sided, nobis.

*Form.* Bill a third longer than the head, perfectly entire, conspicuously arched throughout, strong, hard, slender, much compressed with broad convex ridges and plane vertical sides ; upper mandible nearly solid, especially towards the point, lower somewhat scooped ; tomixæ before the nares trenchant erect, scarpt and sub-locked, free and level with the palate towards the tips, which last are obtuse and rather unequal in length ; carination of the culmen restricted but distinct. Plumes of the forehead and head soft ; those of the lares and chin subsetaceous. Tongue somewhat elongated, simple, narrow, cartilaginous ; its tip bifid or jagged. Wings not exceeding the base of the tail, perfectly rounded, bowed ; 5 first quills regularly gradated in a diminishing ratio ; 6th usually longest, the rest insensibly decreasing ; the vanes of all, broad and entire. Tail sub-elongated, not equal to the body and neck, consisting of twelve sub-bowed, moderately broad plumes, of which the 6 centrals are even, and the 6 laterals gradated, but

scarcely an inch in the extreme ones. Tarsi sub-elevate, stout, antecally vaguely scaled, posteally, smooth and sharp. Toes medial, unequal, central fore medially elongated; laterals and hind sub-equal; last shortest but stoutest and sub-depressed basally, sometimes equal to the inner fore. Nails rather large, compressed, somewhat straightened and obtuse; lateral forces equal; central larger; hind largest; orbits nude as in *Cinclosoma*.

*Colour and Size.* Above olive brown, laterally together with a narrow band round the brows, the lining of the wings, the thighs, and entire undertail coverts, bright rusty. Below, white, dashed on the top of the breast with dusky: a hoary spot before the eye: a short dusky moustache from below the gape: remiges and rectrices internally dusky brown: tail transversely rayed with deeper toned lines—seemingly a generic mark: legs fleshy grey: bill horn colour with the ridge darkened basally: iris hoary: orbital skin smooth and deep blue: size  $10\frac{1}{2}$  inches by  $11\frac{1}{2}$ , and  $2\frac{1}{2}$  oz.: bill (in straight line)  $1\frac{1}{2}$ : tarsus  $1\frac{1}{2}$ : central toe  $1\frac{5}{8}$ : hind toe  $1\frac{9}{8}$ .

N. B. The sexes are alike in colour, save that the female has no moustache. She is rather less, too, than her mate.

*2d Species, new; SCHISTICERS or slaty pate, nobis.*

Form, as in the preceding, but the bill rather shorter and somewhat more compressed; and the wings and tail slightly but sensibly more elongated.

*Colour and Size.* Above, together with the lower flanks, vent, thighs and undertail coverts, dark olive green: crown, nape and ear coverts, saturate slaty: lores black: from the ear coverts to the midflanks, the sides of the neck and the body are intense ochreous red: a long superciliary white stripe from the nares to the shoulders: below, from chin to belly, pure white: remiges and rectrices, internally dusky: tail, rayed as before: bill bright orange yellow with a blackish base above: iris hoary: orbital skin smooth and slaty: legs fleshy brown with yellowish horn nails: size of the last, but measuring rather more in extent owing to the cause above mentioned: 11 inches long by  $12\frac{1}{4}$  wide, and  $2\frac{1}{2}$  oz.: bill  $1\frac{3}{8}$ : tarsus  $1\frac{1}{2}$ : sexes alike.



*3d Species*, new ; *RUFICOLLIS*, rusty naped, nobis.

Form less typical, the bill being shorter and straighter than in either of the foregone, obviously leading towards *Timalia*. Colour and size, olive green, paler and shaded with white on the breast and belly, and merging in pure white on the chin and throat : a broad rusty band round the back of the neck : lores and ear coverts confluent blackish : a superciliary white line from the brows to the nape : no transverse rays on the unbowed tail : bill, sub-orange with a blackish base : legs plumbeous : iris variable, sanguine, brown, or hoary : size small :  $8\frac{1}{4}$  by  $9\frac{1}{2}$  inches, and 1 oz. : bill 1 : tarsus  $1\frac{1}{4}$  : central toe  $\frac{3}{4}$  : hind toe  $\frac{1}{2}$  : sexes alike, but female rather less.

*Sub-genus*, *TIMALIA*. *4th Species*, new ; *NIPALENSIS*, nobis. Nipalese *Timalia*, nobis.

*Form*. Bill assimilating closely with the last named species, but stronger and straighter ; equal merely to the head in length, subarcuated only, but distinctly so, and perfectly entire. Culmen rather more carinated between the nares, the tect of which is less hard and less arched than in the typical *Pomatorhini*. Rictus more strongly bristled. Shafts of the head and neck-plumes, spinous, as in *Cinclosoma setifer* (nobis). Legs stronger with more distinct scales ; another approximation to *Cinclosoma*. Tail equal to the whole body and bill, consisting of 12 broad, and straight, but frayed, feathers, the extreme laterals of which are gradated by half the entire length of the tail, or doubly as much as in the foregone species.

*Colour and Size*. Above, with the flanks, thighs and under tail coverts, brown ; paler and more olive beneath than superiorly. Below, from chin to breast, rufescent ; from breast to vent, albescent ; and both shaded with a tinge of the colour above. Entire cheeks, pure white : iris, hoary blue : bill and legs, dull dark plumbeous : the whole plumage black shafted : the outer vanes of the prime quills paled : sexes alike : size 10 inches by 10, and  $2\frac{1}{4}$  oz : bill 1 : tail 5 : tarsus  $1\frac{7}{8}$  : central toe  $\frac{1}{2}$  : hind  $\frac{9}{16}$ .

*5th Species* ; *PELLORIS*, brown ear, nobis.

Characters, extremely similar to those of the last, but returning towards the typical *Pomatorhini* by its shorter and rayed tail.

*Colour and Size.* Above, dull olive green, inclining towards brown : thighs, vent and under tail coverts, the same but paler : checks, concolorous with the body : ear coverts, darker and brown : below, white, tinted with rufous towards the head, and shaded with the colour of the thighs and vent, towards them. Bill above and towards the tip, blackish : below, pure plumbeous : legs, pure plumbeous grey : iris, hoary : whole plumage black shafted, as in the last, and similarly spinous : tail closely rayed across : size of the last but not measuring so much in length, owing to the shorter tail, 9 inches by 10, and  $2\frac{1}{4}$  oz. : bill  $1\frac{1}{8}$  : tarsus  $1\frac{3}{8}$  : central toe  $\frac{1}{16}$  : hind toe  $\frac{1}{8}$  : tail 4 : sexes alike.

*6th Species.* *Subgenus*, PRINIA ? SUYA, nobis.

*Character.* Bill scarcely equal to the head, perfectly entire, strong, obtuse, inclining to an arcuate form, subdepressed as far as the nares, cylindrico-compressed beyond them. Culmen carinated half way, acutely convex ; tips of both mandibles obtuse ; that of the upper longer and inclining over the lower. Tomiæ erect, trenchant, remote from the palate, and interlocked throughout.

Nares medial, half way from gape to tip, lunato-elliptic, and shaded above by a small nude subarched scale. Rictus rather wide and strongly bristled. Plumes of the forehead rigid. Nape furnished with several long slender hairs. Tongue cartilaginous, simple, its tip bifid or jagged. Wings rounded, rather feeble, not bowed, 5th and 6th quills usually longest and exceeding the tertiaries by  $\frac{1}{2}$  an inch.

Tarsi elevated, stout, crossed by three or four scales. Toes medial, compressed, outer connected to the joint, laterals and hind subequal ; last stoutest but not depressed ; nails rather acute, hind one much the strongest. Tail very long and wedged, consisting of 10 narrow, feeble plumes which are greatly and equally gradated throughout.

*Type and species new ?* PRINIA ? CRINIGER, nobis. SUYA CRINIGER, nobis.

*Suya* of the Nipalese.

*Form*, has been detailed above. *Colour and Size.* Above, dusky brown, darker on the cap, paler on the tail. Below, rufescent yellow,

shaded on the breast and flanks with the colour of the superior surface ; lining of wings, and quills internally towards their bases, buff. Bill dusky or black ; legs fleshy grey ; iris brown : sexes alike ; female smaller, and her tail shorter : size of the male, 8 inches by 7 : tail  $4\frac{1}{2}$  : bill  $\frac{5}{8}$  : tarsus  $1\frac{1}{8}$  : central toe  $\frac{5}{8}$  : hind toe, plus  $\frac{3}{8}$ .

*General Remarks.* The whole of the above species are distinguished, in common, by hard, entire, compressed bills, feeble wings, gradated tails, and stout ambulatory legs and feet. The structure of their stomachs, intestines and tongues, too, is similar, as are their food and customary haunts. Comparing the *Pomatorhini* proper with the *Cinclosomæ*, I can perceive no essential difference of structure except in the bill ; which however, is marked ; nor any in the manners of the two, except that the former take somewhat more vegetable food and adhere to the forests ; whilst the latter scarcely ever touch berries, never grain, and adhere to the bushy downs and *skirts* of the forests. In searching for their food, the *Cinclosomæ* make a free use of their legs, like the *Rasores* ; the *Pomatorhini* proper and the *Timaliæ*, as free a use of their bills, in the fashion of *Upupa*.\* The *Cinclosomæ* are more gregarious than the *Pomatorhini* ; the *Pomatorhini* than the *Timaliæ* ; and the *Timaliæ* than the *Prinia* vel *Síyæ* ; which last are solitary and silent. The others are almost equally noisy ; and all of them more or less gregarious. All save the *Síyæ* have a wide range throughout the hills, which, however, they never quit. The *Síyæ* seem almost confined to the central region.

Of the *Síyæ* the favourite site is those upland downs which are scattered with brushwood. Owing to the feebleness of their wings, they need the shelter of low trees and shrubs. But they are almost perpetually on

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\* It seems to me singular that Dr. HORSFIELD did not compare his *Pomatorhinus* with *Upupa* or *Promerops* rather than with *Cinnyris*. The bill of *Pomatorhinus*, like that of *Upupa*, is a common coarse instrument, fitted for digging ; whilst that of *Cinnyris* is exquisitely delicate in all its details ; and, like the bill of *Trochilus*, is remarkable for the deep interlocking of the tomiae. The *very opposite* is the characteristic of the bill of *Pomatorhinus*.

the ground, seeking their food there exclusively. Small scaled insects are their favourite food, with larvæ and their eggs ; next, grubs and caterpillars.\* Berries they seldom touch ; never grain, nor hard seeds, nor consequently, gravel. The *Pomatorhini* and *Timaliæ* have, essentially, the same habits ; both being distinguished from their *Cinclosomæ* by their non-graminivorous diet, and avoidance of the deep forests ; unless the characters of *Prinia*, as of *Cinclosoma*, *Pomatorhinus* and *Timalia*, want emendation, our *Síyæ* can scarcely belong to the sub-genus *Prinia*. But I entertain a confident expectation that the alleged *notch* in the bill of *Prinia*, as well as the stated *feebleness* of its tarsi, will be found to be the exception and not the rule. The *Síyæ* are calculated to remind the student, in various ways, of *Maturus*, *Megalurus* and *Synallaxis*, as well as of *Prinia*. Their strong entire bills, elevated powerful legs, and terrestrial habits, are, however, their preponderant characteristics, and those which induce me, with the subordinate peculiarities above detailed, to consider them as a subgenus of *Pomatorhinus*, having first referred the latter to the *Crateropodinaæ*.

The more general characteristics of the whole of our birds are exceedingly well given by Mr. SWAINSON (Northern Zoology. Aves. p. 156) as those of the Crateropodine or long-legged Thrushes—a very natural and useful aggregation of birds in my judgment. Dr. HORSFIELD was disposed to refer *Pomatorhinus* to the Tenuirostral *Cinnyridæ* ; and it has been actually disposed among the *Meliphagidæ* ! Yet it is one of the *most terrestrial* of the *whole order of Insessores* ; feeding exclusively on ground insects ; and bearing a very close relationship, both in the structure of its bill and in the manner of using it to procure food, to the Genus *Upupa* ;† which latter, all terrestrial as it is, has been classed with the *Certhiadaæ* ! Compression, entireness, and solidity, in a slender rostrum are carried to the climax in *Upupa* : but the gradual accession of these attributes may

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\* The species which frequent the grass and low vegetation : *not* the arborial kinds.

† The common *Hoopoe* is a familiar tenant of our lawn from September till May ; but is never seen in Nepal proper during the hot and rainy months.

be distinctly traced through *Cinclosoma* and *Pomatorhinus*. *Timalia*, again, has been removed by systematists, *toto cælo*, from *Pomatorhinus* and from *Prinia*: and yet there can hardly be a question that *Timalia* forms a sub-generic link, uniting the two, and also connecting the genus *Pomatorhinus* with the genus *Cinclosoma*. I possess a series of *Pomatorhini*, *Timaliæ*, and *Cinclosomæ*, which blend insensibly with each other, at the same time that they collectively exhibit, in a striking manner, the general attributes of Mr. SWAINSON'S *Crateropodinæ*.

Nèpal, August 29th.

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## IX.—NEW SPECIES OF MOTACILLINÆ.

WITH INDICATION OF A NEW GENUS BELONGING TO THIS SUB-FAMILY.

SYLVIADÆ. MOTACILLINÆ. *Sub-Genus*, new; DAHILA nobis.

*Type*, DAHILA DOCILIS, nobis.

No. 439 of the new series of Specimens and Drawings in possession of the Zoological Society of London.

The birds of this genus in both structure and habits are a perfect compound of *Turdus* and *Motacilla*.\* The bill in all its details, and the feet are Merulo-motacilline, but with a more decided leaning to the Thrush than to the Wagtail. The tarsi are stronger and more elevated than in either genus, the thumbs broader and the nails more acute. The wings are shorter than in either genus, and exhibit the form and proportion seen in *Enicurus*: that is, the 5th quill is longest; the 1st and 2d abruptly; the 3d and 4th slightly gradated up to it; and the tertials (not† scapulars) are short, broad and fine. The tail composed of 12 feathers, is shorter than in *Motacilla*, longer than in *Turdus*; its six lateral plumes are considerably gradated from

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\* Regarding the two genera in the large sense, or as emblematic of the respective sub-families, and *not* merely as genera.

† It is the tertials, not the scapulars of *Motacilla* which are elongated, notwithstanding the general doctrine of books.

below ; its six centrals even, and its form sub-cuneate. The general structure of these birds is robust and nearer to *Turdus* than to *Motacilla* ; but the pied plumage and habit of flirting the tail, are borrowed from the latter genus.

The song is the Thrush's : the murary and arboreal nesting, rather Meruline than Motacilline. And so, too, the non-migratory habits ; for the Wagtails proper leave us at their " appointed season," whilst the Thrushes, (like the *Enicuri*) are permanent. Many of the Wagtails, so long as they stay, familiarly occupy our gardens and lawns, seeking their food exclusively on the ground, and using the bushes only for shelter, but without perching. These, excepting the last peculiarity, are the manners of our *Dahila* which, like *Motacilla*, has an almost exclusively animal diet, seldom and only from necessity eating berries or unripe vetches and such comparatively soft vegetable substances. So far, then, there is a greater leaning to *Motacilla* than to *Turdus*, which latter is freely baccivorous : Nor do the Dahils wholly avoid the open banks of streamlets ; for I have seen them there in company with the Wagtails. But their usual protected and arboreal site, with their free habit of perching, are decidedly more Turdine than Motacilline. The Dahils, however, dislike and avoid the *interior* of woods, to which the Thrushes are partial ; and the former are less permanently, or (to speak nicely) more fitfully upon the ground than the latter. The usual food of the Dahils is grubs, worms, beetles, grasshoppers, crickets and their consimilars, tenants of the surface or subsurface of the Earth. Rarely, in winter, they take unripe vetches and such like ; but never gravel, nor sand, nor the hard seeds which the former help the digestion of. The Dahils, if found in the wilds, tenant meadows and grass land, provided with brush-wood ; but they are no where so common as in gardens and on lawns, which they enliven, in spring, by their song, and, at all times, by their vivacity and familiarity. They move quickly on the ground, yet perch firmly and readily, frequently watching for their prey on a low twig to which they return as soon as they have beaten it to death on the ground. They never seize on the wing.

When cattle pass their way they will partially attend on the herd descending occasionally from their perch to snap up the insects and grubs brought to light by the act of grazing. The Dahils are perpetually in motion, and raise and depress the body with flirtation of the tail, exactly in the Wagtail manner. Their habits of society, in respect to their own kind, are solitary or nearly so ; except in the breeding season when these monogamous and attached birds steadily unite to rear and defend their young. The female usually lays 5 spotted eggs, bringing up from 3 to 4 young ones ; and but once a year, unless the first brood has failed or been rifled from her. The nest is carelessly made of grass, but is always placed in a secure and sheltered position, commonly a hole in a wall, sometimes the interior of a low thick prickly plant. The Dahil is one of the boldest and most docile of birds ; and is perpetually caged both for his song and his pugnacity. Few of the Thrushes have a finer note ; nor is it degraded by apish tricks of imitation, though this intelligent bird will lend its courage for the profit or amusement of its keeper. In the spring the male Dahils are perpetually challenging each other, and no sooner is the defiance of one uttered than it is answered by another.

The professional bird keeper, availing himself of this propensity, takes out his tame male on his fist, and proceeds to the nearest garden or grove. The bird, at his bidding, presently challenges : the wild one immediately answers : the former is then slipt, and a desperate contest ensues between the two, during which the fowler readily secures the wild bird, with the tame one's assistance ; for, the latter will deliberately aid his owner's purpose, seizing the wild bird, at the critical moment, with both claws and bill and retaining it till his master come up, in case it has not been so much exhausted by the previous contest as to be disabled from flying away upon the man's approach. Fighting the tame birds is a favourite amusement of the rich ; nor can any race of game cocks contend with more energy and resolution than do these singular Motacillo-Meruline species.

*Indication of generic character.* Bill, feet, and habit of body, Meruline : tip of the lower mandible, vaguely recurved and notched : tarsi high,

stout, and nearly smooth ; the thumb, nearly equal to the inner fore toe and sub-depressed : the nails acute.

Wings, round-acuminate ; 5th longest : 1st and 2nd greatly, 3rd and 4th trivially, gradated : the tertials, short, firm and composed.

Tail, 12, subelongate, firm, erigible, considerably gradated on the sides.

Nape frequently furnished with a few slender hairs.

The above character has been composed with special reference to the two genera *Turdus* and *Motacilla* ; and upon the assumption that our Genus be referred to the Motacilline Sub-family of the *Sylviadæ*.

1st Species, new ; *DOCILIS*, nobis.

*Colour and Size.* Head, neck and breast, with the body above and the wings, blue glossed black : a broad central stripe throughout the whole length of the wing : the body below and the 8 lateral tail feathers, pure white : bill and legs, black : iris dusky brown :  $8\frac{1}{2}$  to 9 inches long by  $11\frac{1}{2}$  wide, and  $1\frac{1}{2}$  to  $1\frac{3}{4}$  oz. in weight : tarsus  $1\frac{6}{8}$  : central toe  $\frac{1}{16}$  : hind toe  $\frac{9}{16}$  : its nail  $\frac{5}{8}$  : tail  $3\frac{1}{4}$ .

Sexes alike. The young have the breast ruddy and the glossed black parts of the upper plumage : at first, olive brown, then blackish, slaty and un-glossed, including the breast : their feet are slaty, and their bill dusky brown.

2nd Species ? *MOTACILLA VARIEGATA* Auctorum.

3rd Species ? *TURDUS SOLITARIUS* Auctorum.

Genus *MOTACILLA*. Sub Genus, *ENICURUS*, Tem.

Species, new ; *SCHISTACEUS*, nobis.

Form, as in *MACULATUS*, but somewhat less in size.

*Colour.* Head, neck, back and flanks, dark slaty blue : cheeks, throat and a very narrow band round the bill, jet black : a white frontal band above the last from eye to eye : whole neck and body below, with the rump and upper tail coverts, white : wings and tail precisely as in *Maculatus*, save that the blanching of the alar quills at their bases is more extended and reveals itself like a speculum on the primaries. Bill, legs, and iris, as in *Maculatus*, and indeed in all the other species ; for I know



not one which has not white feet, a black bill, and brown iris. Sexes alike, very nearly allied to *Velatus Temminckii*.

*2nd Species.* FULIGINOSUS, nobis.

Size and form, as in *Maculatus*. Head, neck, back and breast, dusky, or sooty brown: lower back or rump, and body below, white: wings and tail, bill and feet, as in *Maculatus*; but the black hue less pure and jetty. Sexes alike.

*3d Species.* IMMACULATUS, nobis.

Form as in *Maculatus* and coloured exactly similarly, save that the breast is white, and the mantle immaculate. Size not larger than *Scouleri*, allowance being made for the long and typical tail of our species. Sexes alike, and bill, feet and iris, as before.

*Remark.* The discovery of *Scouleri* proves that 'tail forked' is a dubious mark of this genus, or rather subgenus, for such only is the value of the group. Very nearly as it is affined to *Motacilla*, I should distinguish it, chiefly, by its lunate nares nearly closed by an unarched membrane, its gradated wings with short tertials, and its bristly gape.

The tarsi are higher and smoother, but *not* more slender, than in *Motacilla* proper, several species of which have similar claws.

*Genus.* MOTACILLA Auctorum.

*Subgenus.* BUDYTES CUVIER.

*Species,* new; CALCARATA, nobis, closely allied to *M. Neglecta*. Obviously distinguishable from the typical Wagtails by the shortness of the tail, the superior height and strength of the tarsi, and the longer, straighter, and extremely acuminate nails; the hind one of which is longer than its toe, and, in our species, as nearly *straight* as may be,  $7\frac{3}{4}$  inches long, whereof the tail is but  $3\frac{1}{2}$ , extending only two inches beyond the tips of the wings. Expanse of wings 11 inches, weight less 1 oz.: bill  $\frac{1}{8}$  of inch, and equal to head. Tarsus  $1\frac{3}{8}$ : central toe  $\frac{1}{8}$ : hind  $\frac{1}{8}$ : its claws  $\frac{7}{8}$ . Above the flanks, grey slaty: below, bright yellow: a yellow line on each side the head, above the eye, from bill to nape: wings, 6 central tail feathers, and upper coverts of tail, black: the great coverts of wings and the alar plumes, very widely margined below, and also tipped with white: the

6 lateral rectrices, much blanché, increasingly to the extremes which are nearly all white: legs black: bill horn grey: iris brown. Female considerably less:  $6\frac{3}{4}$  inches long: similar to the male, but more dully coloured, and the alar and caudal black plumes of the male, brown in her.

MOTACILLA PROPER *Species*, new; ALBOIDES, nobis.

The oriental analogue of *Alba*, cui simill.; but clearly distinguishable by its white throat, its completely black neck, and the greater blanching of its wings which, when closed, show nothing but white, except on the tertials.

*Colour and size of mature male.* Forehead, cheeks, and throat, white, divided by a narrow black line from the gape. Back of the head, with the whole neck, breast, shoulders, body above, and 8 central tail feathers, jetty: 4 lateral caudals, with the body below and greatest portion of the closed wing, white: quills black internally, and apertly so on the tertials which, however, have very broad margins of white: bill and legs jet: iris brown: 8 inches long by  $11\frac{1}{2}$  wide, and less; 1 oz. in weight: tail  $3\frac{3}{4}$ : tarsus  $\frac{1}{8}$ : central toe  $\frac{9}{16}$ : hind  $\frac{5}{8}$ : its claw  $\frac{3}{8}$ : wings  $2\frac{1}{2}$  inches short of tail. Amidst all the changes of plumage to which this species is liable, I still think I may safely say that the female (like the young) is slaty above, and white below, with a black gorget on the breast, and a blackish zone round the cheeks: wings, mostly black brown, with a narrow white edging.

*Remark.* By comparing the proportions of this species with those of *Calcarata*, the characteristic difference of structure in *Motacilla* and *Budytes* may be at once perceived.

I am answerable for reducing *Enicurus* and *Budytes* to the station of Sub-genera; but, their internal structure, their habits and manners, are so similar that I cannot imagine the small discrepancy of external structure can want generic division. Certainly, however, there is this difference in the manners of the *Enicuri*, as compared with the *Motacilla*, that the former love the sheltered rills; the latter, the open streams; and the respective formation of the wing in each may be relative to those opposite habits. Through *Enicurus* and our *Dahila*, we are led easily from the

Wagtails to the Thrushes ; and it is well worthy of notice that the two former have wings of exactly the same construction.

With regard to *Budytes*, much as its lark-like claws prepare us to expect some peculiarity of manners, I have failed thus far to perceive any, as compared with *Motacilla* proper.\*

In place of the 'unguis posticus *arcuatus*' of the generic character, I should read 'nails (all) straightened, slender, very acute: the hind one equal to its digit or longer?'

In our *Dahila*, also, the nails are *acute* ; but they are strong and curved ; and the very slight but perceptible depression or flatness of the soles of the feet distinctly indicates the perching and meruline propensity of *Dahila*.

The bill of *Dahila*, as compared with that of *Turdus*, is scarcely so thick, rather more depressed at the base, and rather less convex forwards upon the ridge ; and the tip of its lower mandible shows evanescently the recurvation and notch so conspicuous in many of the *Lancidæ*, and distinct though fainter in some of the *Muscicapidæ* and even of the *Sylviadæ*. But these distinctions are all nice ; and the general and effectual character of the bill of *Dahila* is Turdine. So too that of the legs, though here the superior height and strength of the tarsi with the depression of the thumb, and acuteness of the nails, are palpable distinctions. I have not noticed in either *Motacilla* or *Turdus*, the nuchal hairs of *Dahila*, and which with the strength of the tarsi seem to intimate a Crateropine tendency in our genus, harmonising well the shortened wings and gradated tail of *Dahila*, as compared with the genera to which it is related by affinity.

*Nepal, Sept. 1836.*

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\* Thus much however may be said with truth ; that the short-clawed Wagtails often frequent lawns and meadows ; the long-clawed, seldom or never ; and that the foot of the latter is admirably suited to support the birds upon the most yielding and semi-fluid sand-banks, or the precise situations to which they are almost limited.

XIII.

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NOTE

ON THE

URSUS SIVALENSIS,

A NEW FOSSIL SPECIES,

FROM THE

SIVÁLIK HILLS.

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BY CAPTAIN P. T. CAUTLEY,  
*Superintendent Doáb Canal,*

AND

HUGH FALCONER, M. D.,  
*Superintendent Botanical Garden, Sehâranpur.*

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WE are now enabled to record another new form in fossil zoology drawn from the rich deposits of the Sivalik hills. In a preceding article we have noticed a new feline extinct species, of dimensions approaching those of the existing Tiger; in the present one, we shall endeavour to characterize another member of the same family, of the genus *Ursus*, essentially distinct from existing or extinct species in some prominent points of its osteology, and remarkable also for large size, like some other of its associated fossil contemporaries.

Our knowledge of the species is derived from two fossil specimens. The one consisting of the right half of the lower jaw mutilated at the symphysis, and ascending portion of the ramus, exhibited in Fig. 2, gave us the first idea of a new animal. The other, Fig 1, a subsequent acquisition, is a superb specimen of the head, which although a good deal fractured, is at the same time so well preserved in its principal features as to give little difficulty in determining the specific character. The three

rear molars are perfect on one side and but little damaged on the other. Both canines are present, and that of the right side is entire. The alveoli of the false molars and incisors are distinct, although the teeth are wanting. The only considerable deficiencies are in the posterior and lower parts of the occiput, both zygomatic arches, and in the lower end of the nasals, where a fissure extends across the face, on both sides towards the orbits.

The chief peculiarities of the fossil are to be found in the teeth, which are constructed more after the type of the higher Carnivora than any other described species of the genus. Before entering upon these it will be convenient, for comparison, shortly to refer to the dentary system of the Bears generally.

The number of the teeth varies more in the different species of the Bears, than in any other genus of the Carnivora. The incisors, canines, and the three posterior molars are constant in both jaws, in all the species. The false molars are subject to great variation. They are usually entirely wanting\* in the upper jaw of the *Ursus spelæus*, or large fossil Bear of Europe, while in other species they amount to three on either side. The same variation holds in the lower jaw. In the *Ursus labiatus*† there are four false molars on each side, while in the *Ursus spelæus* there is generally but one present: so that while the number of teeth in the former extends in both jaws to 42, it is commonly reduced in the latter to 30. This irregularity in the number of the false molars, exists to a certain extent in different individuals of the same species. In one skull of the *Ursus Tibetanus* in our collection, which belonged to an old animal, there are three false molars in the upper jaw on each side; while in the skull of a younger individual with unworn teeth, there are but two. In another skull, there are no false molars on the left side, while there is one on the right side: there being at the same time three false molars on either side of the lower jaw.

The characters depending on the form of the teeth are very constant in the genus. The carnassier or ante-penultimate molar, in the upper

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\* CUVIER, Ossements Fossiles, tom. 4. p 351.

† This is constant in several skulls in our collection.

jaw, has but two lobes or points, along its length; and the tubercle of its inner side is placed opposite the rear lobe. The two rear molars are oblong, and the last one has the additional developement of a crenulated spur or heel. The higher Carnivora differ widely in these characters from the Bears; their carnassier teeth being three lobed, and the tubercle of the inside being placed forwards, as in the Cats and Hyæna; while the rear or tubercular teeth are reduced in number, and are rudimentary.

We shall now proceed to the teeth of the fossil, which in many respects deviate from the type of the genus, and approximate that of the more perfect Carnivora. Along with the dimensions we annex those of the *Ursus Spelæus* and *Ursus Tibetianus* for comparison.\*

<i>Molars, Upper Jaw.</i>	<i>Ursus Sivalensis.</i>		<i>Ursus Spelæus.</i>		<i>Ursus Tibetianus.</i>	
	<i>Inch.</i>	<i>Metre.</i>	<i>Inch.</i>	<i>Metre.</i>	<i>Inch.</i>	<i>Metre.</i>
Length of last molar, .....	1.1	.028	1.84	.048	1.1	.028
Width of ditto, .....	1.2	.03	....	....	0.6	.015
Length of penultimate ditto, .....	1.2	.03	1.23	.031	0.8	.02
Width of ditto, .....	1.2	.03	....	....	0.55	.013
Length of ante-penultimate ditto, .....	1.3	.032	0.83	.021	0.5	.012
Width of ditto, .....	0.85	.022	....	....	0.35	.008
<i>Molars, Lower Jaw.</i>						
Length of last molar, .....	....	....	1.03	.026	0.65	.017
Width of ditto, .....	....	....	....	....	0.48	.012
Length of penultimate ditto, .....	1.15	.029	1.30	.032	0.8	.02
Width of ditto, .....	0.75	.019	....	....	0.45	.011
Length of ante-penultimate, .....	1.35	.0335	1.32	.033	0.8	.02
Width of ditto, .....	....	....	....	....	0.38	.005
Length of last false molar, .....	0.9	.023	....	....	0.4	.01
Width of ditto, .....	0.5	.012	....	....	0.25	.006

The incisors as indicated by the alveoli were 6, and the external one of each side larger than the others, as is usual in the family. The canines are of great size. The right one is entire: its point is worn off, indicating

\* In the *Ossements Fossiles*, CUVIER does not give the dimensions in width of the teeth of the *Ursus Spelæus*. We have to regret this omission, as one of the most marked characters about our fossil is the great width of the molars; and we have no other source to refer to regarding the *Ursus Spelæus*, besides the *Ossements Fossiles*.

the animal to have been more than adult, and there are also stripes of wear both on its posterior and inner sides. It is 1.4 inch in anteroposterior diameter at the base, and 1 inch transversely. The socket of the first false molar is close behind the canine, that of the second is near the anterior one, and the tooth appears to have been two fanged. There can have been no other false molars besides these two, the sockets of which are close together, and occupy the interval between the canine and carnassier, which is inconsiderable for the size of head, being but 1.2 inch in length.

The three rear molars present marked peculiarities. The antepenultimate or carnassier is of very large size; it slightly exceeds both of the rear teeth in length, and is about half an inch longer than the corresponding tooth of the *Ursus Spelæus*. Instead of having but two points like the rest of the Bears, it has three, the anterior lobe being well developed as in the higher Carnivora; and the tubercle of the inside, instead of being to the rear as in the other species, is advanced forwards opposite the middle lobe. It has altogether a great analogy with the corresponding tooth of the Hyæna. The teeth of the opposite sides are unequally worn.

The two rear or tubercular molars are also marked in their form. Instead of being oblong, as in all the other species, with their length greater by a third than the breadth, they are square in our fossil. The penultimate, if any thing, is longer than the rear one, the reverse of which holds in the rest of the genus. It has two tubercles at its outer side as in other species; at the inside it is somewhat shortened in length, and the cleft between the tubercles is nearly obsolete, so as to give the appearance of one large tubercle. In this respect there is a remote analogy with the corresponding tooth of the Dog, and a deviation from the usual type of the Bears. The last tubercular is as contrasted in form with that of the other species as the carnassier tooth is. At its outer side there are two tubercles to the crown smaller than in the penultimate, as is normal in the genus, and at its inner side a ridge indistinctly divided by three slight furrows. There is no heel to the tooth: The crown is square, and the only part which can be considered as representing a heel or spur is a flattish disk at the inside, alternate with the posterior outer tubercle, and partly opposed to the rear

portion of it. None of the rest of the Bears have the last tubercular in the upper jaw square, or without a crenulated spur added on to the rear of it.

Our specimen of the lower jaw, Fig. 2, is deficient in the incisors and in the protruded portion of the canine. It is broken off, just where the latter emerges from its socket. The section of the imbedded portion of the canine gives 1.6 inch of vertical dimension and .95 transversely. The molars are six in number. The two anterior false molars and the last tubercular have dropped out, but the sockets remain unobliterated. The anterior false molar was close behind the canine, and there is not space for another to have been inserted between. The second was close to the first and almost in contact with the third false molar. This latter, like the carnassier of the upper jaw is of large size, compared with the same tooth of the other species, and distinctly three lobed ; which is another peculiarity, and further supports the analogy shown by the upper carnassier with the *Hyæna*, to the second false molar of which it bears a considerable resemblance. The anterior and posterior lobes are small, the middle point being chiefly developed. The antepenultimate or carnassier is so defined, as to give no indication of form to notice except its length. The penultimate or first tubercular molar is oblong. It is broader for its length than generally holds in the genus, and the crown less complicated with tubercles. Of the rear tubercular, the socket alone remains, the tooth having fallen out. It is situated with considerable obliquity to the rest of the series, in the root of the ascending portion of the ramus. The alveolus is inconsiderable, and the tooth appears to have been comparatively small.

The teeth in the fossil appear to have been thus : incisors  $\frac{1}{1}:\frac{1}{1}$  : canines  $\frac{1}{1}:\frac{1}{1}$  : false molars  $\frac{2}{3}:\frac{2}{3}$  : cheek teeth  $\frac{1}{1}:\frac{1}{1}$  : in all 38.

The size and form of the head bear out the specific distinction established by the teeth. No Bear, fossil or recent, attains the enormous size of our fossil, except the *Ursus spelæus*, and the absence of any bulge in the forehead above the orbits at once distinguishes it from the latter. The mutilation of the cranium at the occiput, prevents an exact comparison of the length with that of the *Ursus spelæus*. In the tables of the Ossements



Fossiles,\* an adult specimen of the latter measures 17.9 inches from the incisives to the occipital crest. The fossil cranium although mutilated at the occiput, measures 17 inches : with the deficient portion restored, it would probably measure 19 inches. The facial half of the head, from the post-orbital processes to the incisives, measures 9.3 inches ; and in almost all the Bears the cranial portion is longer than the facial. Supposing this proportion to hold in our fossil the head would be more than 19 inches, and exceed that of the *Ursus spelæus*.

The form of the cranium in profile is shown in Fig. 1. The most striking feature is the almost rectilinear outline, and absence of any notable curvature. From along the nasals to between the intraorbital processes is almost a straight line. There is but a trifling degree of convexity from that backwards : and the sagittal crest rises in a very prominent ridge above the parietals. No species of Bear has so straight a cranium. The *Ursus spelæus* is chiefly characterised by a bulge of the forehead above the root of the nasals. The only species which at all approaches the fossil in profile is the white Polar Bear, *Ursus maritimus*.† But besides the great difference of size, the latter has nothing of the salient sagittal crest, which is so prominent in the fossil ; all the other Bears have more or less convexity of profile.

Exclusive therefore of the teeth, the size and cranial outline would suffice to establish the fossil, as a distinct species. The other peculiarities of the head are these. The frontal is very broad, although an accidental indented fracture on the brow takes off from the measurement. The orbits have considerable obliquity, and large size, the depth from the postorbital process to the malar margin being 3.1 inches. Their anterior margin only advances to above the posterior surface of the rear molar. The temporal ridges are but slightly marked and meet at an open angle as in the *Ursus spelæus*. From their commissure backwards there is scarcely any sink, the sagittal crest starting with great prominence from the parietals. The crest is not complete in its whole length, being broken off obliquely towards

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\* Tom. 4, p. 359.

† Ossements Fossiles, tom. 4, lab \* \* Fig.

the occipital. The parietals swell out backwards and downwards. The cranial cavity appears to have expanded much laterally, towards the occiput, which is broken off. The temporal fossæ are of great depth and extent; the zygomatic arches on both sides are wanting; judging from the depth of the temporal fossæ they must have been of great expanse. The malar apophysis comes off low and is  $2\frac{1}{2}$  inches in height. The nasals are partly removed by a fissure in the fossil extending across the face. They appear to have been rather long and the external opening of the nostrils to have been much shorter and less oblique than in the *Ursus spelæus*. The muzzle is broad and obtuse; being about one-fourth of the length of the head, and a little wider than the interorbital portion of the frontal. In this respect it resembles the *Ursus labiatus*. The palate is strongly arched both longitudinally and transversely: the greatest depth from a line across the worn molars, to its surface, being 2.3 inches. The horizontal plate of the palatines, hardly extends an inch beyond the rear molar; whereas in a head of the *Ursus labiatus* measuring a foot in length, it extends more than two inches. The palatine sinus is also proportionably narrow for the size of head.

In place of a single suborbital foramen, there are three distinct foramina nearly of the same size, placed over each other and a few lines apart. They are considerably advanced on the jaw, the uppermost being 1.6 inch from the margin of the orbit and placed over the carnassier. It is difficult to say whether this is common to the species or merely an individual peculiarity. Nothing of the sort is seen upon the heads figured in the *Ossements Fossiles*.

We only know the lower jaw by the fragment represented in Fig. 1. It consists of the greater part of the body of the right side, broken off where the canine protrudes. It is also deficient in the articulating and coronoid processes. There is therefore little to remark about the form. The lower edge has a good deal of curvature backwards, and the outer surface is deeply indented by a muscular hollow towards the angle. The dimensions of the fragment are thus:

Extreme length of the fragment.....	10.3 inch.
Height of jaw over 1st false molar.....	2.5
Ditto between the two rear molars.....	3.0
Greatest thickness at rear molar .....	0.9

We have not yet found out or identified any bones of the trunk or extremities. The species does not appear to have been abundant, as no other specimens of the head or teeth have been discovered, so far as we know, among the immense collections of fossil bones got from the Sivalik Hills.

The dimensions of the cranium, contrasted with some of the measurements of the *Ursus spelæus* for comparison, are thus :

<i>Dimensions of Cranium.</i>	<i>Ursus Sivalensis.</i>		<i>Ursus Spelæus.</i>	
	<i>Inch.</i>	<i>Metre.</i>	<i>Inch.</i>	<i>Metre.</i>
* From the incisives to the occipital crest, .....	....	....	17.9	.457
Width of cranium between post-orbital processes, ..	5.45	.139	4.7	.121
From the incisives to a line between ditto, .....	9.3	.237	8.6	.215
* From occipital crest to the same point, .....	....	....	11.2	.285
Width of brow between the orbits, .....	4.7	.121	....	....
Do. of muzzle over the canines, .....	4.8	.122	....	....
Length from the alveoli of the incisors to the posterior margin of the palate, .....	7.3	.186	....	....
Width of palate in the interval between the carnassiar molars, .....	3.35	.085	....	....
Interval between the canines, .....	2.7	.07	....	....

\* These two measurements are incomplete in the fossil, from the mutilation at the occiput. The first or extreme length is 17 inches or .434 metres, the second 7.7 inch or .197 metres.

To conclude. It follows, that there existed along with the Mastodon, Sivatherium, Fossil Camel, &c. of the Sivalik deposits, a large distinct species of Bear, equalling if not exceeding the largest known of the genus. Its teeth deviated widely from the type of the genus, approximating it more to the higher Carnivora than to any other species ; the carnassier teeth of the upper jaw connecting it with the Hyæna while the tuberculats have a more remote analogy with those of the Dog. The size and extent of the temporal fossæ and the prominence of the sagittal crest, taken in conjunction with the teeth, show that it had a more strictly carnivorous than a frugiverous habit.

We have designated it *URSUS SIVALENSIS*.

# XIV.

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## DAILY REGISTER

OF THE

## TIDES AT SINGAPORE,

FROM THE

1ST SEPTEMBER 1834 TO THE 31ST AUGUST 1835, INCLUSIVE.

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OBSERVED

By Mr. J. DIAS.

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[The present Register was kept in pursuance of an order from the Honorable the Court of Directors, dated the 20th February, 1833, for the purpose of aiding the Rev. Professor WHEWELL's investigation of the general cotidal lines on the surface of the globe. In forwarding it to the Bengal Government, (by whom it was liberally placed at the disposal of the Society,) the Resident Councillor, Mr. BONHAM, states that he is not aware what degree of confidence is to be placed in it; the Master Attendant having only three peons attached to his office was unable to spare one for this particular duty, and was forced to employ an extra person who performed the task without any stipulated remuneration for his service, and was finally rewarded with a gratuity of 100 Rupees. It may very reasonably be doubted, under this explanation, whether the Register will prove to be of that value, in a scientific point of view, which might have been expected from its official character; and it is to be feared that the tenor of Professor WHEWELL's instructions and the nature of his elaborate investigation were not duly apprehended, if it was imagined that a mere Register made without due attention, apparently, even to the exact time of the daily maxima and minima,—the state and force of the wind, the set of the current, &c. would answer the purpose required. The official correspondence gives no information as to mode of taking the observations, nor as to the fixation of the Zero-point on the tidal guage—but it is understood that the jetty at Singapore affords every facility on these points, as there is a perpendicular wall washed by the tide which never quits its base at the lowest ebb.

Notwithstanding the evident imperfections above pointed out, the Register has been deemed worthy of preservation, in the uncertainty of procuring more accurate materials, and in the hope that the Professor may be able to glean from it the necessary averages towards fixing the elements of a station so important as Singapore in the discussion of the tidal theory. It would be very desirable to obtain tables even of similarly moderate pretensions of the daily tides at one or two principal stations on the long range of coast upwards from Singapore to Chittagong, and it is hoped that the attention of the Executive Engineers may be invited to the subject. All that seems necessary is to set up a guage at some convenient spot, and to employ an intelligent native servant to read off the rise and fall, and to note the time as nearly as he can estimate it.—SEC.]



DAY.	MORNING TIDE. A. M.						EVENING TIDE. P. M.						WEATHER.	
	Low Water.		High Water.		Range of Tide.		Low Water.		High Water.		Range of Tide.			
	Height.		Height.		of Tide.		Height.		Height.		of Tide.			
	Time A. M.	Time A. M.	Time A. M.	Time A. M.	Time P. M.	Time P. M.	Time P. M.	Time P. M.	Time P. M.	Time P. M.	Time P. M.	Time P. M.		
	H. M.	Ft. In.	H. M.	Ft. In.	H. M.	Ft. In.	H. M.	Ft. In.	H. M.	Ft. In.	H. M.	Ft. In.		
October	1 ...	3 25	5 3	10 20	11 3	6 0	S. S. E.	3 48	5 6	10 50	8 8	5 2	S. S. W.	Cloudy.
"	2 ...	4 0	4 10	10 58	11 0	6 2	S. S. E.	4 30	5 0	11 5	9 9	6 9	Lat. Vble.	Ditto.
"	3 ...	4 48	4 5	11 9	11 10	7 5	S. S. E.	4 40	3 7	11 13	11 6	7 11	S. W.	Ditto.
"	4 ...	5 0	2 8	11 20	10 8	8 0	N. W.	5 20	2 6	10 10	10 11	8 4	S. S. W.	Ditto.
"	5 ...	5 10	2 0	11 50	10 7	8 7	Variable.	5 40	1 9	11 58	10 5	9 2	S. S. W.	Ditto.
"	6 ...	5 28	1 6	12 0	9 10	8 4	S. E.	5 40	1 10	11 55	10 5	8 7	Lat. Vble.	Clear.
"	7 ...	6 4	1 8	1 0	10 0	8 4	S.	7 0	1 10	1 30	11 2	9 4	S. W.	Light rain.
"	8 ...	8 30	1 5	2 10	10 8	9 3	S. W.	8 48	2 0	3 0	10 0	8 0	S.	Cloudy.
"	9 ...	9 30	1 11	3 38	10 8	9 8	S. E.	9 50	2 4	4 0	10 0	7 8	Lat. S.	Clear.
"	10 ...	10 12	1 10	4 7	9 5	7 7	S. S. W.	9 15	1 5	3 40	9 7	8 2	S. E. S.	Ditto.
"	11 ...	9 40	2 8	4 45	9 6	6 10	N. W.	10 0	3 6	5 6	9 10	5 4	W.	Cloudy.
"	12 ...	10 35	4 8	5 15	9 9	5 1	S. W.	11 10	2 6	6 5	10 4	7 10	Winds.	Showers.
"	13 ...	11 50	4 6	6 50	9 10	5 4	S.	0 30	5 4	7 40	10 6	5 2	S. S. E.	Clear.
"	14 ...	1 20	4 8	8 35	9 8	5 0	N. W.	2 35	5 6	9 30	10 0	4 6	N. W.	Rain.
"	15 ...	3 50	5 4	10 0	9 10	4 6	W.	4 15	4 10	10 28	10 7	5 9	S. W.	Cloudy.
"	16 ...	4 25	4 7	10 55	10 5	5 10	Variable.	4 48	4 0	11 15	9 8	5 8	Variable.	Hazy.
"	17 ...	5 10	4 2	11 30	10 9	6 7	S.	5 45	3 0	11 58	10 5	7 5	S. W.	Cloudy.
"	18 ...	6 10	4 2	0 20	10 3	6 1	Lat. Vble.	6 35	3 5	0 30	10 6	7 1	S.	Ditto.
"	19 ...	6 50	4 0	0 40	10 9	6 9	N. W.	6 55	3 5	0 48	10 4	6 11	W.	Ditto.
"	20 ...	6 38	2 10	0 55	10 6	7 8	S. W.	6 40	3 0	0 50	10 0	7 0	S. W.	Clear.
"	21 ...	6 45	5 0	0 55	10 5	5 5	S. W.	6 53	2 10	1 0	10 4	7 6	S. W.	Rain.
"	22 ...	7 0	4 6	0 0	10 0	5 10	S. to S. W.	7 5	2 4	1 6	11 8	9 4	W.	Light rain.
"	23 ...	7 10	5 0	1 10	10 6	5 6	S. E.	7 20	3 3	1 25	11 10	7 7	S.	Cloudy.
"	24 ...	8 5	6 0	1 40	11 0	5 0	Variable.	8 40	4 0	2 40	11 8	7 8	Calm.	Hazy.
"	25 ...	9 10	6 3	3 0	11 5	5 2	S. W. to W.	9 35	5 4	3 30	11 0	5 8	W.	Clear.
"	26 ...	10 40	7 0	4 10	10 5	3 5	Winds.	11 20	3 4	4 50	10 10	7 6	S. W.	Cloudy.
"	27 ...	11 58	4 5	5 26	10 4	5 11	S. W.	0 50	4 9	6 10	9 0	4 3	S. E.	Clear.
"	28 ...	1 10	5 3	6 40	10 4	5 1	N. N. W.	1 33	5 0	7 10	10 1	5 1	N. N. W.	Squally.
"	29 ...	1 47	5 4	7 47	9 10	4 6	S. W.	2 4	5 0	8 10	10 2	5 2	S. W.	Clear.
"	30 ...	2 43	4 6	8 35	10 11	6 5	Calm.	3 0	4 9	8 58	11 0	6 3	S. S.	Cloudy.
"	31 ...	3 40	5 7	9 45	11 8	6 1	S.	4 50	4 4	10 50	10 9	6 5	S.	Clear.

## REGISTER OF THE TIDES AT SINGAPORE.

DAY.	MORNING TIDE. A. M.						EVENING TIDE. P. M.						WEATHER.	
	Low Water.			High Water.			Low Water.			High Water.				Range of Tide.
	Range of Tide.			Range of Tide.			Range of Tide.			Range of Tide.				
	Time A. M.	Height		Time A. M.	Height		Time P. M.	Height		Time P. M.	Height			
	H. M.	Ft. In.		H. M.	Ft. In.		H. M.	Ft. In.		H. M.	Ft. In.		Ft. In.	
1834.														
November 1	4 20	6 1	10 40	12 8	6 7	S. E.	5 5	4 2	11 25	10 4	6 2	S. W.	Cloudy.	
" 2	5 5	6 2	11 40	13 0	6 10	N. E.	5 45	4 3	11 50	10 6	6 3	W.	Ditto.	
" 3	5 55	6 4	12 10	13 8	7 4	W. Y.	6 15	3 6	12 40	12 5	8 11	W.	Ditto.	
" 4	6 30	5 7	1 0	12 3	6 6	N. E.	7 10	2 10	1 15	12 2	9 2	W.	Clear.	
" 5	7 30	6 6	1 30	10 6	4 30	W.	8 0	3 2	1 35	11 6	8 4	N. W.	Heavy rains.	
" 6	8 10	7 2	2 0	10 10	2 8	N. E.	9 0	3 2	2 10	12 0	8 10	N. E.	Showers at times.	
" 7	9 10	8 0	2 30	11 0	3 0	N. E.	10 0	5 0	3 0	12 0	7 2	N. Y.	Passing showers.	
" 8	10 20	8 0	4 0	11 0	3 0	N. E.	11 0	5 2	4 20	10 5	5 3	N. E.	Cloudy.	
" 9	11 15	8 5	5 0	10 5	2 0	N. E.	12 0	6 5	5 0	9 2	2 7	N. E.	Ditto.	
" 10	12 15	7 5	6 0	9 7	2 2	N. E.	1 30	7 10	7 30	9 0	1 2	N. E.	Ditto.	
" 11	2 0	6 0	8 0	9 8	3 8	N. E.	2 15	7 0	8 10	9 8	2 8	N. E.	Ditto.	
" 12	3 0	5 7	9 0	10 0	4 5	N. Y.	3 0	6 0	9 30	10 4	4 4	N. E.	Ditto.	
" 13	3 30	5 2	9 50	10 4	5 2	N. E.	4 0	5 5	10 0	10 10	4 1	N. E.	Rain.	
" 14	4 0	5 7	10 15	11 6	5 11	N. E.	4 15	5 2	10 45	11 2	6 0	N. E.	Clear.	
" 15	4 45	4 11	10 50	11 8	6 9	N. E.	4 50	4 9	11 0	11 6	6 9	N. E.	Rain.	
" 16	5 15	5 9	11 0	11 3	5 6	N. Y.	5 18	3 7	11 40	10 6	6 11	N. E.	Cloudy.	
" 17	5 30	5 0	11 45	11 5	6 5	N. E.	5 38	3 5	12 0	10 10	7 5	N. E.	Fine.	
" 18	6 0	5 8	12 0	10 7	4 11	N. E.	6 10	3 6	12 50	10 10	6 4	S.	Cloudy.	
" 19	6 30	5 10	12 15	11 5	5 7	N. E.	6 44	3 3	1 12	10 8	7 5	N. E.	Ditto.	
" 20	6 50	5 7	12 50	11 4	5 9	S.	7 0	3 4	1 30	10 0	6 8	S.	Heavy rain.	
" 21	7 8	5 2	1 50	11 0	5 10	E.	7 30	3 5	2 0	9 10	5 5	E.	Squally and rain.	
" 22	7 55	5 10	2 14	9 8	3 10	E.	8 0	3 11	2 0	9 0	5 1	E.	Rain.	
" 23	9 12	4 8	2 14	10 0	3 3	N. E.	9 20	5 0	3 0	10 0	5 0	N. E.	Clear.	
" 24	9 28	7 0	3 10	10 3	3 3	N. E.	0 0	4 6	3 30	10 30	5 9	Variable.	Rain.	
" 25	10 0	4 6	4 0	9 6	5 0	E.	0 5	7 8	3 30	9 8	2 0	E.	Cloudy.	
" 26	10 45	4 8	3 48	9 8	5 0	N. E.	2 0	6 0	8 4	10 5	4 5	N. E.	Rain.	
" 27	2 10	3 4	8 40	10 9	7 5	N. E.	12 25	3 0	8 40	10 8	7 8	N. E.	Fine.	
" 28	2 30	3 0	8 50	11 2	8 2	N. E.	13 0	5 1	9 10	11 4	6 3	E.	Squally.	
" 29	3 15	5 3	9 15	12 2	6 11	N. E.	4 0	4 11	10 0	11 2	6 3	N. E.	Cloudy.	
" 30	4 10	3 4	11 0	11 6	8 2	N. E.	5 15	3 10	11 20	11 11	8 1	N. E.	Hot.	

# REGISTER OF THE TIDES AT SINGAPORE.

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DAY.	MORNING TIDE. A. M.				EVENING TIDE. P. M.				WEATHER.
	Low Water.		High Water.		Low Water.		High Water.		
	Range of Tide.		Range of Tide.		Range of Tide.		Range of Tide.		
	Time A. M. H. M.	Height Ft. In.	Time A. M. H. M.	Height Ft. In.	Time P. M. H. M.	Height Ft. In.	Time P. M. H. M.	Height Ft. In.	

1834.	December	1 ...	5 30	4 3	11 30	11 9	7 6	N.	5 30	1 11	11 35	10 11	9 0	N. W.	Cloudy.
"	"	2 ...	5 15	4 0	11 45	11 11	7 11	N.	6 0	1 9	0 20	11 10	10 1	N. W.	Ditto.
"	"	3 ...	6 15	4 10	0 10	11 10	10 1	N.	7 0	2 0	0 20	11 10	9 10	N. W.	Ditto.
"	"	4 ...	7 10	4 11	1 0	11 8	6 9	N. W.	8 0	2 4	1 15	11 10	9 6	N. E.	Ditto.
"	"	5 ...	8 15	5 3	2 10	11 5	6 2	N. W.	8 30	3 4	2 20	11 3	7 11	N. W.	Ditto.
"	"	6 ...	9 0	5 1	2 25	11 2	6 1	N. W.	9 10	5 2	2 45	10 9	5 7	N. W.	Rain.
"	"	7 ...	10 0	5 3	3 0	10 6	5 3	N. W.	10 15	5 0	3 20	10 3	5 3	N. W.	Cloudy.
"	"	8 ...	11 0	5 0	4 0	9 9	4 9	N. W.	11 10	4 9	5 0	9 9	5 0	N. E.	Ditto.
"	"	9 ...	12 0	5 9	5 0	9 8	3 11	N.	12 5	6 0	6 0	3 7	3 7	N.	Ditto.
"	"	10 ...	.....	.....	6 36	10 0	.....	N.	1 0	6 7	8 0	9 0	2 3	N. W.	Clear.
"	"	11 ...	2 5	5 10	8 20	10 2	4 4	W.	2 15	6 4	9 0	10 0	3 8	W.	Fine.
"	"	12 ...	3 10	5 6	8 40	10 3	4 9	N.	3 0	5 3	10 0	9 10	4 7	N.	Ditto.
"	"	13 ...	4 0	5 2	10 36	10 5	5 5	N. W.	3 5	4 0	10 40	10 11	5 10	N. W.	Ditto.
"	"	14 ...	5 10	4 4	11 10	10 8	6 2	N. W.	5 36	5 1	11 20	10 11	6 4	N. W.	Rain.
"	"	15 ...	5 50	4 4	11 45	10 6	6 2	N. E.	5 55	3 4	11 30	9 8	7 6	N. E.	Cloudy.
"	"	16 ...	6 0	5 0	11 37	11 0	6 0	N. E.	6 36	3 0	12 0	10 6	7 6	N. E.	Clear.
"	"	17 ...	7 0	5 6	11 40	11 2	5 8	N. E.	6 45	2 4	12 0	10 9	8 5	N. E.	Clear.
"	"	18 ...	8 10	5 6	11 34	11 4	5 10	N. E.	7 0	3 2	1 0	10 6	4 6	N. E.	Ditto.
"	"	19 ...	9 15	6 0	.....	.....	5 6	N. E.	7 25	3 2	1 20	11 8	8 8	N. E.	Sultry.
"	"	20 ...	10 15	7 0	1 10	10 11	3 11	N. E.	9 0	3 4	3 0	12 0	8 8	N. E.	Fine.
"	"	21 ...	8 35	7 1	2 0	11 0	3 11	N. E.	10 0	4 10	3 25	11 2	6 4	N. E.	Clear.
"	"	22 ...	9 10	7 2	3 15	11 2	4 0	N.	11 0	3 11	4 50	10 0	6 1	N. E.	Fine.
"	"	23 ...	10 10	8 0	4 45	10 8	2 8	N.	.....	.....	6 0	10 4	.....	N. E.	Clear.
"	"	24 ...	12 5	4 8	5 10	10 8	6 0	N. E.	1 50	6 0	7 30	10 8	4 8	N. E.	Cloudy.
"	"	25 ...	1 36	6 0	7 0	10 5	4 5	N. E.	2 0	5 8	8 0	10 4	4 8	N.	Fine.
"	"	26 ...	.....	.....	8 0	10 8	4 8	N. E.	3 15	5 2	9 0	10 9	5 7	N.	Rain and squally.
"	"	27 ...	3 0	4 1	8 46	11 3	7 2	N. E.	3 46	2 4	10 0	11 0	8 8	N. E.	Rain.
"	"	28 ...	3 25	4 3	9 37	11 4	7 1	N. E.	4 10	2 8	10 20	11 1	8 5	N. E.	Ditto.
"	"	29 ...	4 0	6 3	10 15	11 7	5 4	N. E.	5 5	2 4	10 36	11 2	8 10	N.	Clear.
"	"	30 ...	4 15	5 10	10 26	11 10	6 0	.....	6 0	2 0	12 10	11 7	9 7	N.	Ditto.
"	"	31 ...	5 26	3 5	10 46	11 8	8 3	N.	.....	.....	.....	.....	.....	N.	Ditto.



## REGISTER OF THE TIDES AT SINGAPORE.

DAY.	MORNING TIDE. A. M.				EVENING TIDE. P. M.				Wind.	WEATHER.
	Low Water.		High Water.		Low Water.		High Water.			
	Range of Tide.		Range of Tide.		Range of Tide.		Range of Tide.			
	Time A. M. H. M.	Height Ft. In.	Time A. M. H. M.	Height Ft. In.	Time P. M. H. M.	Height Ft. In.	Time P. M. H. M.	Height Ft. In.		

January	1 ...	6 30	6 6	.....	.....	1 20	11 3	.....	.....	Clear.
"	2 ...	7 10	6 7	.....	.....	.....	.....	.....	.....	Ditto.
"	3 ...	7 20	6 4	.....	.....	2 25	11 9	.....	N. E.	Fine.
"	4 ...	7 30	6 0	.....	.....	1 40	11 4	.....	N. E.	Rain.
"	5 ...	7 40	6 0	.....	.....	2 10	10 11	.....	N. E.	Ditto.
"	6 ...	8 0	5 11	.....	9 1	2 10	10 4	.....	N. W.	Ditto.
"	7 ...	8 20	5 11	.....	10 1	2 40	10 2	.....	N. W.	Ditto.
"	8 ...	8 40	4 10	.....	10 0	3 35	10 4	.....	N. W.	Ditto.
"	9 ...	9 0	4 10	.....	11 0	4 45	8 9	.....	N. W.	Ditto.
"	10 ...	9 20	4 10	.....	12 5	7 3	5 30	8 7	N. W.	Ditto.
"	11 ...	9 40	4 10	.....	12 0	8 6	7 15	9 7	N. W.	Cloudy.
"	12 ...	10 0	4 10	.....	3 5	8 9	8 35	10 0	Variable.	Cloudy and rain.
"	13 ...	10 20	4 10	.....	3 15	4 10	9 0	10 0	N. E.	Cloudy.
"	14 ...	10 40	4 10	.....	4 5	4 9	10 15	10 8	N. E.	Fine.
"	15 ...	11 0	4 10	.....	5 10	4 8	11 0	11 1	N. W.	Rain.
"	16 ...	11 20	4 10	.....	5 45	3 6	11 35	10 9	N. E.	Drizzling.
"	17 ...	11 40	4 10	.....	7 0	3 5	.....	.....	N. E.	Showers.
"	18 ...	12 0	4 10	.....	7 0	2 7	0 30	12 5	N. E.	Fine.
"	19 ...	12 20	4 10	.....	8 0	2 9	1 30	11 0	N. E.	Squally.
"	20 ...	12 40	4 10	.....	8 0	3 5	2 0	11 2	N. W.	Rain.
"	21 ...	1 0	4 10	.....	9 5	4 10	2 20	11 9	N. E.	Cloudy.
"	22 ...	1 20	4 10	.....	9 30	5 1	3 0	11 9	.....	Frequent showers.
"	23 ...	1 40	4 10	.....	10 50	7 8	4 0	10 7	.....	Ditto.
"	24 ...	2 0	4 10	.....	11 15	4 5	5 5	20 9	.....	Showers.
"	25 ...	2 20	4 10	.....	.....	.....	7 0	10 3	N. E.	Fine.
"	26 ...	2 40	4 10	.....	2 45	3 0	9 5	11 0	N. E.	Hazy.
"	27 ...	3 0	4 10	.....	3 5	3 8	10 11	2 7	N. E.	Cloudy.
"	28 ...	3 20	4 10	.....	4 10	3 1	10 25	1 8	N. E.	Hazy.
"	29 ...	3 40	4 10	.....	5 20	2 11	11 25	1 1	N. E.	Fine.
"	30 ...	4 0	4 10	.....	6 35	2 9	12 0	11 4	N. E.	Hot.
"	31 ...	4 20	4 10	.....	7 10	2 11	0 15	12 6	N. E.	

# REGISTER OF THE TIDES AT SINGAPORE.

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DAY. 1835.	MORNING TIDE. A. M.						EVENING TIDE. P. M.						WEATHER.
	Low Water.		High Water.		Range of Tide. Ft. In.	Wind.	Low Water.		High Water.		Range of Tide. Ft. In.	Wind.	
	Time A. M. H. M.	Height Ft. In.	Time A. M. H. M.	Height Ft. In.			Time P. M. H. M.	Height Ft. In.					
February	1 ...	7 35	7 2	11 6	4 4	N. E.	8 0	3 7	1 0	12 3	8 6	N. E.	Fine.
"	2 ...	9 0	7 6	11 2	3 8	N. to N. E.	7 50	4 4	1 45	11 8	7 1	N. to N. E.	Clear.
"	3 ...	8 30	7 5	2 50	2 5	N. E.	8 25	4 8	2 35	11 1	6 5	N. E.	Dry.
"	4 ...	9 10	7 9	2 45	9 10	N. E.	9 0	5 3	2 30	10 6	5 3	N. E.	Clear.
"	5 ...	9 5	7 9	3 0	9 8	N. E.	8 45	4 3	3 15	9 7	5 4	.....	Passing showers.
"	6 ...	9 20	7 9	3 15	9 7	N. E.	9 9	6 5	3 30	9 0	2 7	N. E.	Clear.
"	7 ...	10 20	4 3	5 15	9 5	N. E.	10 43	4 6	.....	.....	4 11	N. E.	Dry, hot.
"	8 ...	11 23	5 4	5 30	9 5	N. E.	9 2	6 10	.....	.....	2 7	N. E.	Clear.
"	9 ...	0 35	5 5	6 40	9 11	N. E.	1 10	4 10	8 0	9 9	4 11	N.	Fine.
"	10 ...	2 5	5 3	10 0	8 0	N. E.	3 5	3 10	9 10	8 0	4 2	.....	Clear & hot.
"	11 ...	3 15	4 11	9 20	10 3	N. E.	3 5	3 0	9 15	9 11	6 11	N. E.	Dry.
"	12 ...	3 55	6 1	10 0	10 10	N. E.	4 0	2 11	10 0	10 3	7 4	S.	Clear.
"	13 ...	4 15	6 3	10 40	11 6	N. E.	4 20	2 1	10 40	10 11	8 10	N.	Dry hot.
"	14 ...	5 0	6 6	10 45	11 0	N. W.	4 25	2 4	10 50	10 11	8 7	N. W.	Clear.
"	15 ...	5 7	6 0	11 5	12 3	N. E.	6 0	2 9	.....	.....	9 6	N.	Ditto.
"	16 ...	7 0	5 3	12 10	11 7	N. E.	7 20	2 8	1 0	12 1	9 5	N.	Dry hot.
"	17 ...	8 0	5 5	1 20	11 5	N. E.	7 55	4 7	1 50	11 10	7 3	N. E.	Ditto.
"	18 ...	8 25	3 4	2 15	11 5	N.	7 55	4 8	2 0	11 8	7 0	S. W.	Passing showers.
"	19 ...	8 55	3 2	2 15	10 11	N. E. to S. E.	8 40	4 6	2 55	11 2	6 8	.....	Cloudy & Squally.
"	20 ...	9 15	3 11	3 5	10 8	N. & N. E.	9 35	4 0	3 53	9 11	5 11	Variable.	Showers.
"	21 ...	10 0	3 5	3 40	9 6	S. W.	11 10	5 6	4 30	9 4	3 10	N. E.	Fine.
"	22 ...	12 0	4 5	5 15	10 2	N. E.	.....	.....	6 0	9 3	4 10	N.	Ditto.
"	23 ...	1 15	5 11	7 20	9 11	N. E.	1 35	3 7	7 25	9 4	5 9	S.	Cloudy.
"	24 ...	1 35	5 2	8 0	9 7	N. E.	2 30	3 2	8 40	9 11	6 9	N. E.	Clear.
"	25 ...	3 0	4 8	9 15	10 4	N. E.	3 30	3 1	9 25	10 7	7 6	S. W. to N. E.	Cloudy.
"	26 ...	4 5	4 0	9 45	10 11	N.	4 25	2 11	10 15	10 11	7 11	N. E.	Clear.
"	27 ...	4 30	3 8	10 20	11 4	N.	5 0	2 7	11 0	11 1	8 6	N.	Cloudy.
"	28 ...	5 15	3 9	11 10	11 6	S. E.	5 20	2 9	12 0	10 9	8 0	N. E.	Clear.

DAY.	MORNING TIDE. A. M.						EVENING TIDE. P. M.						WEATHER.		
	Low Water.			High Water.			Low Water.			High Water.					
	Height.		Range of Tide.	Height.		Range of Tide.	Height.		Range of Tide.	Height.		Range of Tide.			
	Time A. M.	H. M.		Time A. M.	H. M.		Time P. M.	H. M.		Time P. M.	H. M.				
1835.	H. M.	Ft. In.	H. M.	Ft. In.	H. M.	Ft. In.	H. M.	Ft. In.	H. M.	Ft. In.	H. M.	Ft. In.	Wind.		
March	1 ...	6 15	3 10	11 4	0 35	7 4	6 25	2 11	0 50	11 0	8 1	0	E.	Clear.	
"	2 ...	7 10	3 11	10 5	1 5	8 8	6 55	3 4	0 35	11 5	8 3	7	1	E.	Fine.
"	3 ...	7 0	2 11	10 7	1 30	8 8	7 30	3 4	1 10	11 5	8 1	8	2	E.	Squally.
"	4 ...	8 5	2 9	10 10	1 45	9 9	7 15	4 9	1 20	10 11	6 2	6	1	N. E.	Dry hot.
"	5 ...	8 0	2 4	11 1	1 45	9 9	7 30	5 4	1 50	11 0	5 8	5	8	N. W.	Rain.
"	6 ...	7 45	4 7	10 8	2 20	6 3	8 5	5 3	2 5	10 2	4 11	4	11	N. W. to N.	Cloudy.
"	7 ...	8 0	4 4	10 8	3 15	6 3	9 10	6 7	2 45	8 11	2 4	4	11	N. W.	Showers of rain.
"	8 ...	9 25	5 4	11 0	4 3	6 3	10 5	6 3	3 35	8 4	2 1	2	1	N. E.	Cloudy.
"	9 ...	10 20	4 11	9 3	5 20	4 8	11 15	6 2	4 35	8 3	2 2	4	1	N. E.	Fine.
"	10 ...	11 40	4 9	9 5	6 50	4 8	.....	.....	7 0	9 2	4 5	5	3	N. E.	Cloudy.
"	11 ...	1 0	6 1	10 0	8 20	3 6	2 45	4 0	9 0	10 1	6 1	6	1	N. E.	Heavy showers.
"	12 ...	2 10	5 7	10 4	9 15	4 3	3 7	2 11	9 30	10 5	7 6	2	2	N. E.	Passing showers.
"	13 ...	3 0	4 5	10 4	10 45	5 11	3 7	2 11	9 30	10 5	7 6	2	2	N. E.	Rain.
"	14 ...	3 40	3 10	9 45	10 11	7 1	3 45	2 6	9 50	10 8	8 8	2	2	N. E.	Ditto.
"	15 ...	4 20	3 5	10 25	11 6	8 1	4 40	2 8	11 9	10 11	7 3	3	3	S. E.	Heavy showers.
"	16 ...	4 57	3 4	11 50	12 1	7 6	5 46	2 9	12 0	11 4	8 7	1	7	N. E.	Clear.
"	17 ...	6 20	3 10	.....	.....	6 6	7 10	3 2	0 40	12 3	9 1	8	2	S. W.	Heavy rain.
"	18 ...	7 5	4 3	10 9	1 15	10 9	7 45	3 5	1 35	11 7	8 2	8	1	S. W.	Cloudy.
"	19 ...	8 0	2 7	10 5	1 57	10 5	8 16	3 11	2 20	10 8	6 9	9	2	S. E.	Ditto.
"	20 ...	8 40	2 3	11 11	2 30	9 11	9 17	5 3	3 20	10 4	5 1	3	1	S. W.	Ditto.
"	21 ...	9 25	3 3	11 8	3 5	9 8	11 5	6 2	4 26	9 5	3 3	1	7	S. W.	Ditto.
"	22 ...	11 17	3 9	10 2	5 37	9 2	12 0	7 3	5 40	8 10	1 7	7	5	S. W.	Clear.
"	23 ...	11 30	3 10	6 15	8 8	4 10	.....	.....	7 25	8 5	4 7	7	3	S. W.	Cloudy.
"	24 ...	1 27	7 8	7 0	8 8	1 0	1 27	3 11	8 0	9 2	5 3	4	3	N. E.	Ditto.
"	25 ...	2 10	6 8	8 17	9 35	11 1	2 36	3 11	9 0	10 3	6 4	4	4	N. to N. W.	Rain.
"	26 ...	3 25	6 2	9 35	11 1	4 11	4 10	5 4	10 17	11 8	6 0	6	4	N. E.	Rain & cloudy.
"	27 ...	4 26	6 0	10 0	12 0	6 0	4 35	5 3	10 20	3 11	6 0	10	6	N. E.	Rain.
"	28 ...	4 27	6 2	10 37	11 8	5 6	4 40	5 0	11 7	11 10	6 10	7	2	N. E.	Ditto.
"	29 ...	5 16	4 8	11 30	11 10	7 2	5 27	4 6	11 50	11 8	7 5	7	5	N. E.	Cloudy.
"	30 ...	5 48	4 3	12 0	11 10	7 7	5 30	4 5	.....	.....	.....	.....	.....	N. E.	Ditto.
"	31 ...	5 27	4 0	11 10	0 16	7 10	5 55	4 8	0 45	11 9	7 1	7	1	N. E.	Ditto.

# REGISTER OF THE TIDES AT SINGAPORE.

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DAY.	MORNING TIDE. A. M.						EVENING TIDE. P. M.						WEATHER.		
	Low Water.			High Water.			Low Water.			High Water.				Range of Tide. Ft. In.	
	Time A. M. H. M.	Height Ft. In.	Time A. M. H. M.	Height Ft. In.	Time A. M. H. M.	Height Ft. In.	Time P. M. H. M.	Height Ft. In.							
1835.															
April	1 ...	5 45	4 11	.....	.....	6 10	N. E.	6 0	4 3	1 0	11 0	0	9	N. E.	Cloudy.
"	2 ...	7 27	3 3	.....	.....	7 8	N. E.	7 30	5 4	1 50	11 3	0	11	N. E.	Do. & rain.
"	3 ...	8 7	3 3	.....	.....	7 10	N. E.	7 56	5 9	2 0	10 2	0	11	N. E.	Clear.
"	4 ...	8 5	3 7	.....	.....	6 10	N. E.	7 45	5 10	2 0	10 1	0	10	N. E.	Fine.
"	5 ...	8 20	2 10	.....	.....	5 7	N. E.	8 37	6 4	2 25	9 4	0	4	N. E.	Ditto.
"	6 ...	9 0	3 8	.....	.....	4 10	N. E.	9 47	7 1	3 35	9 4	0	4	N. E.	Showers.
"	7 ...	10 15	4 3	.....	.....	4 5	N. E.	11 20	7 3	4 30	8 4	1	1	N. E.	Cloudy.
"	8 ...	Noon	5 0	.....	.....	4 5	N. to N. E.	.....	.....	7 0	9 7	4	7	.....	Rain.
"	9 ...	2 0	7 10	.....	.....	4 11	N. E.	1 50	4 1	8 30	9 7	5	6	N. E.	Fine.
"	10 ...	2 37	6 9	.....	.....	3 11	S. W.	2 40	3 8	9 17	8 6	0	6	S. W.	Dry hot.
"	11 ...	3 10	4 11	.....	.....	5 8	S. W.	3 30	3 8	10 0	10 5	6	9	S. W.	Ditto.
"	12 ...	3 55	4 2	.....	.....	7 7	S. W.	4 36	3 1	10 35	10 11	7	10	S. W.	Fine.
"	13 ...	5 15	3 8	.....	.....	7 7	S. W.	5 20	3 1	11 7	10 11	7	10	S. W.	Clear.
"	14 ...	5 30	2 11	.....	.....	8 7	S. W.	5 35	3 1	11 30	11 7	8	6	S. W.	Dry hot.
"	15 ...	6 5	2 2	.....	.....	9 5	S. W.	6 25	3 7	0 30	11 6	7	11	S. W.	Cloudy.
"	16 ...	6 45	1 9	.....	.....	10 0	N. E.	7 5	4 3	1 25	11 0	6	9	S. W.	Sultry.
"	17 ...	7 26	1 9	.....	.....	9 3	S. W.	8 26	4 11	2 45	9 6	4	7	S. W.	Cloudy.
"	18 ...	8 20	2 15	.....	.....	7 7	S. W.	9 50	6 3	4 7	8 11	2	8	S. W.	Slight rain.
"	19 ...	9 20	2 2	.....	.....	6 2	S. E.	10 56	7 4	4 35	8 2	0	10	S. W.	Passing showers.
"	20 ...	10 0	2 10	.....	.....	1 11	S. E.	12 0	7 3	5 27	8 4	1	1	S. E. to S. W.	Cloudy.
"	21 ...	10 45	3 7	.....	.....	2 4	S. E.	0 30	3 7	5 50	8 10	5	3	S. E.	Dry hot.
"	22 ...	.....	.....	.....	.....	3 9	Variable.	2 0	3 6	8 20	9 1	5	8	N. W.	Cloudy.
"	23 ...	2 10	6 7	.....	.....	3 5	N. E. to S. E.	3 15	3 5	10 30	10 1	6	8	N. E. to S. E.	Ditto.
"	24 ...	2 35	5 8	.....	.....	1 5	N.	4 55	3 10	11 10	10 4	6	7	S. E.	Cloudy.
"	25 ...	4 10	5 6	.....	.....	6 7	S. E.	5 15	3 10	11 10	10 4	6	6	S. to S. E.	Clear.
"	26 ...	4 50	3 5	.....	.....	7 5	N.	6 20	4 0	11 20	10 5	6	5	Variable.	Hot sultry.
"	27 ...	5 10	2 8	.....	.....	7 9	S. to S. E.	6 45	4 2	12 10	10 6	6	4	N. & N. W.	Squally.
"	28 ...	5 25	2 5	.....	.....	3 0	N. W.	6 45	4 7	0 25	9 10	5	3	N. W.	Clear.
"	29 ...	6 0	2 5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
"	30 ...	6 35	7 6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

DAY.	MORNING TIDE. A. M.						EVENING TIDE. P. M.						WEATHER.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
	Low Water.			High Water.			Low Water.			High Water.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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	Time A. M.	Ft.	In.	Time A. M.	Ft.	In.	Time P. M.	Ft.	In.	Time P. M.	Ft.	In.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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# REGISTER OF THE TIDES AT SINGAPORE.

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DAY.	MORNING TIDE. A. M.				EVENING TIDE. P. M.				WEATHER.	
	Low Water.		High Water.		Low Water.		High Water.			
	Time A. M. H. M.	Height Ft. In.	Time A. M. H. M.	Height Ft. In.	Time P. M. H. M.	Height Ft. In.	Time P. M. H. M.	Height Ft. In.		
										Range of Tide. Ft. In.
1835.	Wind		Wind		Wind		Wind			
June	1 ...	7 35	2 0	1 55	10 2	8 1	2 2	8 3	7 S. W.	Clear.
"	2 ...	8 25	1 11	2 30	10 0	8 1	2 2	8 2	6 S. W.	Clear.
"	3 D	9 35	2 2	3 18	9 8	7 6	2 4	8 1	4 S. & S. W.	Cloudy.
"	4 ...	10 5	2 5	4 0	9 5	7 0	2 4	8 1	2 .....	Ditto.
"	5 ...	11 0	5 11	4 27	8 11	3 0	2 8	6 5	2 W. & S. W.	Ditto.
"	6 ...	11 45	3 3	5 25	8 9	5 6	2 9	6 4	2 N. W.	Rain.
"	7 ...	.....	.....	6 18	8 9	3 5	2 9	6 3	2 S. W.	Heavy showers.
"	8 ...	.....	.....	8 15	9 0	5 4	2 9	6 3	2 S. W. to N. W.	Cloudy.
"	9 ...	3 0	3 3	9 28	9 4	6 1	2 9	6 3	2 S. W.	Ditto.
"	10 O	4 20	2 1	10 20	10 0	8 11	2 9	6 3	2 S. W. & W.	Hot sultry.
"	11 ...	4 58	1 9	11 15	10 1	8 4	2 9	6 3	2 S. E.	Fine.
"	12 ...	5 20	1 6	12 0	10 4	8 10	2 9	6 3	2 S. W.	Hot sultry.
"	13 ...	7 5	1 3	0 36	11 4	10 1	2 9	6 3	2 S. W.	Hot sultry.
"	14 ...	7 40	1 3	1 50	9 8	8 5	2 9	6 3	2 Variable.	Hot sultry.
"	15 ...	7 58	1 7	2 15	10 0	8 5	2 9	6 3	2 S. W. to W.	Hot sultry.
"	16 ...	9 0	1 10	2 55	10 8	8 10	2 9	6 3	2 S. W.	Hot sultry.
"	17 U	10 10	2 9	3 50	9 11	7 2	2 9	6 3	2 S. W.	Hot sultry.
"	18 ..	10 18	2 9	3 50	9 11	6 2	2 9	6 3	2 S. W.	Hot sultry.
"	19 ...	11 40	3 8	4 48	8 9	4 8	2 9	6 3	2 W.	Hot sultry.
"	20 ...	11 55	3 4	5 40	8 6	4 10	2 9	6 3	2 S. W.	Hot sultry.
"	21 ...	1 50	4 8	8 26	7 10	3 2	2 9	6 3	2 S. E.	Hot sultry.
"	22 ...	3 18	3 10	9 16	8 1	4 3	2 9	6 3	2 S. E.	Hot sultry.
"	23 ...	3 30	3 5	9 30	8 4	4 11	2 9	6 3	2 S. W.	Hot sultry.
"	24 ...	4 17	3 5	10 20	8 7	5 2	2 9	6 3	2 S. E.	Hot sultry.
"	25 ●	4 50	2 3	10 40	8 9	6 6	2 9	6 3	2 W.	Hot sultry.
"	26 ...	5 38	2 0	11 25	9 1	7 7	2 9	6 3	2 W. to S. W.	Hot sultry.
"	27 ...	5 37	1 11	12 0	9 1	7 2	2 9	6 3	2 S. E.	Hot sultry.
"	28 ...	6 38	1 9	0 40	10 4	8 7	2 9	6 3	2 S. E.	Hot sultry.
"	29 ...	7 25	1 8	1 18	10 7	8 11	2 9	6 3	2 S. E.	Hot sultry.
"	30 ...	7 49	1 10	1 38	9 11	8 1	2 9	6 3	2 S. S. E.	Hot sultry.

## REGISTER OF THE TIDES AT SINGAPORE.

DAY	MORNING TIDE. A. M.						EVENING TIDE. P. M.						WEATHER.
	Low Water.		High Water.		Range of Tide.	Wind.	Low Water.		High Water.		Range of Tide.	Wind.	
	Height.		Time A. M.				Height.		Time P. M.				
	H. M.	Ft. In.	H. M.	Ft. In.			H. M.	Ft. In.	H. M.	Ft. In.			
July 1 ...	8 46	2 0	2 10	9 8	7 8	S. S. E.	8 40	5 3	2 30	8 11	3 8	S. S. W. & S. W.	Hot.
" 2 ...	8 50	2 5	2 35	10 5	8 0	S.	9 0	5 3	3 0	9 0	3 9	S. W.	Dry hot.
" 3 ...	9 30	2 10	3 28	10 1	7 3	S.	9 35	5 1	3 47	9 0	4 3	S. W.	Cloudy.
" 4 ...	10 25	3 6	4 0	9 10	7 4	.....	10 59	4 8	4 56	9 0	4 4	S. E. to S. W.	
" 5 ...	11 40	4 2	5 27	9 3	5 1	W.	12 0	4 3	5 45	9 4	5 1	S. W.	Cloudy.
" 6 ...	.....	.....	.....	9 3	5 2	W.	1 5	4 4	6 50	9 8	5 2	S. W.	Cloudy.
" 7 ...	1 15	4 0	7 0	9 3	5 3	Sy. & S. W.	2 5	4 9	7 28	10 0	5 3	Sy. & S. W.	Ditto.
" 8 ...	2 30	2 7	8 40	9 0	6 5	W.	3 36	4 11	8 50	10 3	5 4	W.	Ditto.
" 9 ...	3 50	1 7	9 40	10 5	8 10	S. W.	4 0	5 0	9 55	10 0	5 0	S. W.	Ditto.
" 10 ...	4 27	1 4	10 45	9 4	8 1	S. W.	4 40	5 4	12 0	9 8	4 4	W.	Ditto & rain.
" 11 ...	5 20	1 2	11 59	9 3	8 1	W.	5 40	5 4	12 40	10 0	4 6	S. W.	Heavy rain.
" 12 ...	6 20	1 1	.....	.....	8 7	S. W.	6 38	5 6	12 40	10 0	4 4	.....	Cloudy.
" 13 ...	7 10	1 2	1 18	11 2	10 0	S. E.	7 20	5 3	1 25	9 4	4 1	.....	Hot sultry.
" 14 ...	7 30	1 5	1 30	11 5	10 0	S. E.	7 45	5 3	2 0	9 3	4 0	.....	Cloudy.
" 15 ...	8 37	2 4	2 17	11 5	9 1	S. E.	8 49	5 2	3 18	9 5	4 3	S. E.	Rain.
" 16 ...	9 0	2 8	3 40	10 8	6 28	S. to S. E.	9 5	5 5	3 30	10 5	4 2	.....	Rain.
" 17 ...	9 39	3 7	4 0	9 9	6 2	S. E.	9 40	4 11	4 5	10 3	11	S. to S. E.	Ditto.
" 18 ...	10 15	4 8	4 19	8 11	4 3	S.	10 50	4 10	4 20	8 9	3 11	S.	Hot sultry.
" 19 ...	10 56	5 3	4 57	8 5	3 2	S. W.	11 35	4 8	5 19	8 9	4 1	S. W.	Cloudy.
" 20 ...	11 40	6 0	5 35	8 3	2 3	S. E.	12 0	4 3	6 17	9 0	4 10	S. E.	Clear.
" 21 ...	12 48	4 3	7 20	7 3	3 0	S. E.	2 0	6 2	7 36	9 0	2 9	S. E.	Squally.
" 22 ...	2 29	3 4	8 27	7 8	4 4	S.	2 46	5 10	8 45	9 1	3 3	S.	Clear.
" 23 ...	3 16	3 1	9 28	8 2	5 1	S. E.	3 25	6 2	9 45	9 7	3 5	S. & S. W.	Hot sultry.
" 24 ...	3 47	2 0	10 15	8 7	6 7	S. & S. W.	4 17	5 9	10 25	9 9	4 0	S. to S. W.	Hot.
" 25 ...	4 35	1 9	10 50	8 9	7 0	S. & S. W.	4 46	5 6	10 28	10 1	4 7	S. W.	Low thunder.
" 26 ...	5 18	1 8	11 15	9 2	7 6	S. W.	5 37	5 4	11 46	10 6	5 2	S. W.	Cloudy.
" 27 ...	6 10	1 6	12 0	9 4	7 10	S. to S. W.	6 28	5 3	.....	.....	4 1	.....	Hot sultry.
" 28 ...	6 30	5 1	0 40	10 7	5 6	.....	7 0	4 5	1 0	10 5	6 0	.....	Hot sultry.
" 29 ...	7 46	1 6	1 37	10 11	9 5	S. W.	7 55	4 9	1 40	9 8	4 11	S. W.	Dark squally.
" 30 ...	8 24	2 2	2 10	10 11	8 9	S. W.	8 30	4 10	2 15	9 10	5 0	S. W.	Cloudy.
" 31 ...	8 40	2 11	2 30	11 1	8 2	.....	8 47	4 10	3 19	9 9	4 11	S. W.	Ditto.

# REGISTER OF THE TIDES AT SINGAPORE.

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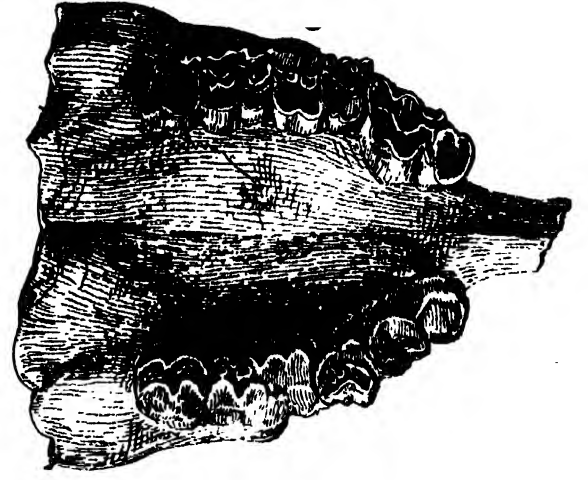
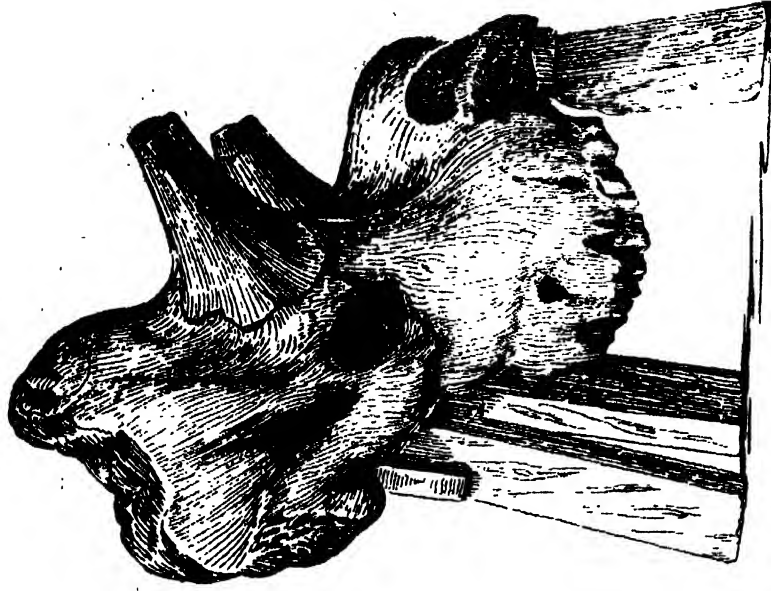
DAY.	MORNING TIDE. A. M.						EVENING TIDE. P. M.						WEATHER.
	Low Water.		High Water.		Range of Tide. Ft. In.	Wind	Low Water.		High Water.		Range of Tide. Ft. In.	Wind	
	Time A. M. H. M.	Height Ft. In.	Time A. M. H. M.	Height Ft. In.			Time P. M. H. M.	Height Ft. In.	Time P. M. H. M.	Height Ft. In.			
1835.													
August	1	9 26	3 5	10 9	7 4	S. W.	9 30	4 2	3 40	9 8	5 6	S. W.	Rain.
"	2	9 45	4 1	10 10	4 11	S. W.	10 19	2 10	4 30	9 9	6 11	S. W.	Ditto.
"	3	11 21	5 4	10 28	8 9	S. W.	11 30	3 8	5 30	9 10	5 2	S. W.	Cloudy & rain.
"	4	11 50	4 5	6 18	8 5	S. W.	12 0	5 0	6 24	8 5	3 5	S. W.	Cloudy.
"	5	0 30	4 4	6 27	9 10	S. W.	1 27	6 2	6 56	8 9	2 7	S. W.	Ditto.
"	6	0 14	4 2	6 38	9 1	S. W.	2 38	6 7	8 50	10 1	3 6	S. W.	Ditto.
"	7	3 10	2 2	9 28	9 8	S. to S.W.	3 24	6 7	9 36	10 9	4 2	S. to S.W.	Hot.
"	8	4 6	1 1	10 39	11 1	S. E. & S	4 23	6 5	10 50	11 1	4 8	S. W.	Cloudy.
"	9	4 50	1 8	11 24	10 3	S. & S.W.	4 58	5 6	11 30	11 7	6 1	S. & S.W.	Ditto.
"	10	5 29	1 9	12 0	10 1	S. W.	6 30	5 2	.....	.....	4 11	S. W.	Rain.
"	11	7 25	1 8	1 15	11 11	S. W.	7 30	4 5	1 50	9 10	5 5	S. W.	Ditto.
"	12	8 38	2 1	1 55	10 11	S. W.	7 58	4 4	2 0	9 7	5 3	S. W.	Clear.
"	13	8 15	3 2	2 16	10 10	S. W.	8 25	4 1	2 25	9 8	5 7	S. W.	Ditto.
"	14	8 47	4 8	2 35	10 9	S. W.	9 0	3 10	2 40	9 7	5 9	S. W.	Cloudy.
"	15	9 39	3 11	3 25	9 8	S. W.	9 45	3 9	3 29	8 2	4 4	.....	Fine.
"	16	9 50	4 2	3 38	8 9	S. W.	9 58	3 3	3 40	8 0	4 3	.....	Rain.
"	17	10 15	5 2	3 50	8 1	S. W.	10 40	4 1	4 26	8 11	4 10	S.	Showers.
"	18	11 10	5 11	5 18	7 18	S. W.	11 47	3 10	5 30	8 10	5 0	S. W.	Cloudy.
"	19	12 0	4 0	6 28	7 13	S. W.	1 19	6 7	6 35	8 7	2 3	S. W.	Ditto.
"	20	1 40	3 11	7 34	7 7	S. W.	1 50	5 0	7 56	8 9	3 9	S. W.	Ditto.
"	21	2 18	3 2	8 0	6 5	S. W.	3 35	5 2	9 40	9 8	4 4	S. W.	Ditto.
"	22	4 18	2 7	10 26	9 0	S. W.	4 20	5 11	10 35	10 4	4 1	.....	Ditto.
"	23	4 27	2 4	10 58	9 2	S. W.	4 38	5 2	11 28	10 4	5 1	.....	Settled.
"	24	5 18	2 3	11 38	10 5	S. W.	6 0	5 0	12 0	10 11	5 11	.....	Cloudy, & showers at times.
"	25	6 38	1 11	.....	.....	S. W.	6 55	4 5	0 38	9 7	5 2	S. W.	Clear.
"	26	6 59	1 8	1 0	11 4	S. W.	7 0	4 1	1 20	9 11	5 10	S. W.	Ditto.
"	27	7 10	1 7	1 24	11 7	S. W.	7 20	3 8	1 30	10 0	6 4	S. W.	Hot.
"	28	7 39	2 2	1 37	11 8	S. W.	8 0	3 1	1 45	10 1	7 0	S. W.	Cloudy.
"	29	8 20	3 0	2 0	11 10	S.	8 46	6 3	2 19	10 0	3 9	S. to S.W.	Ditto.
"	30	9 9	5 1	3 18	10 1	S. E. to S.W.	10 14	6 0	3 45	10 0	4 0	S. to S.W.	Ditto.
"	31	10 38	5 0	4 20	10 0	S. to S.W.	10 58	3 3	4 33	9 11	6 4	S. to S.W.	Ditto.





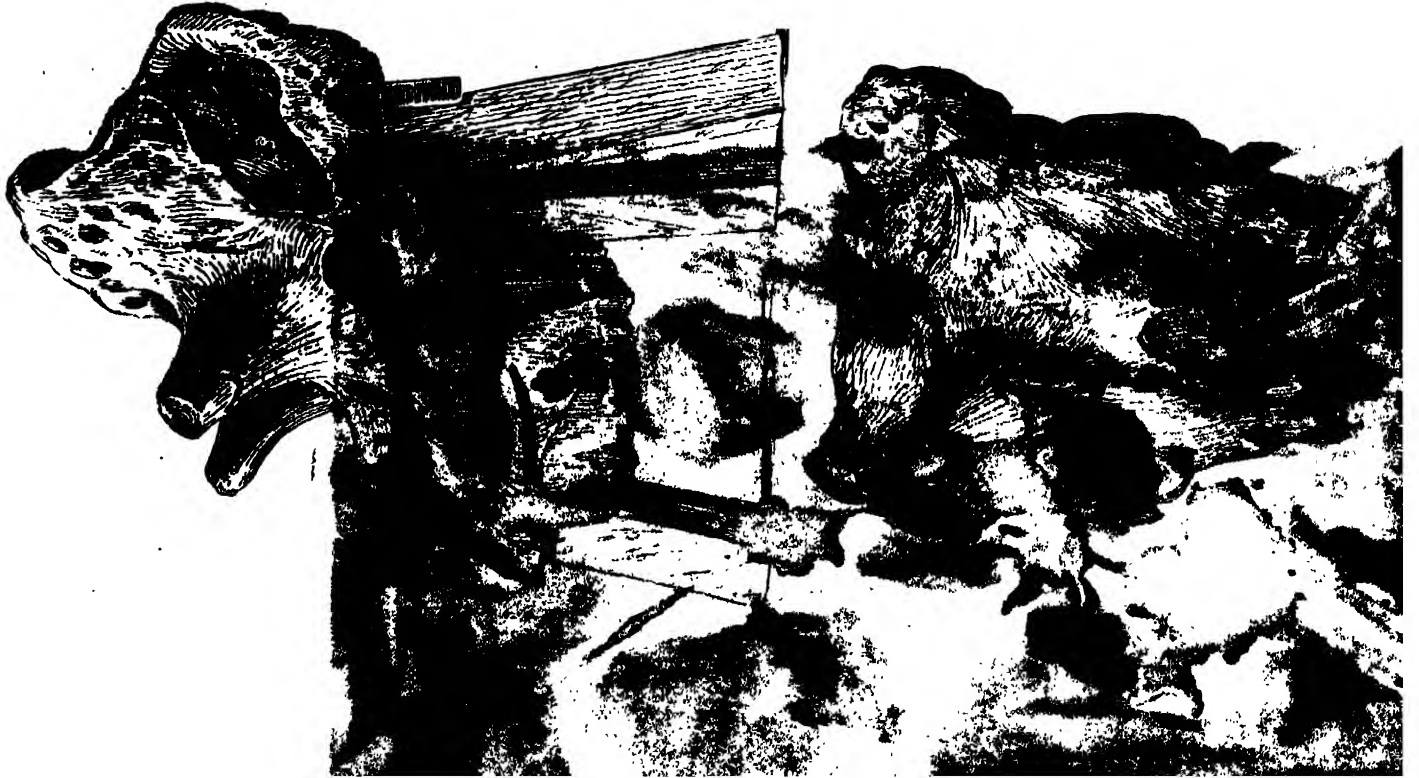
# GIGANTEUM.

of the virginia.



# STATHERIUM

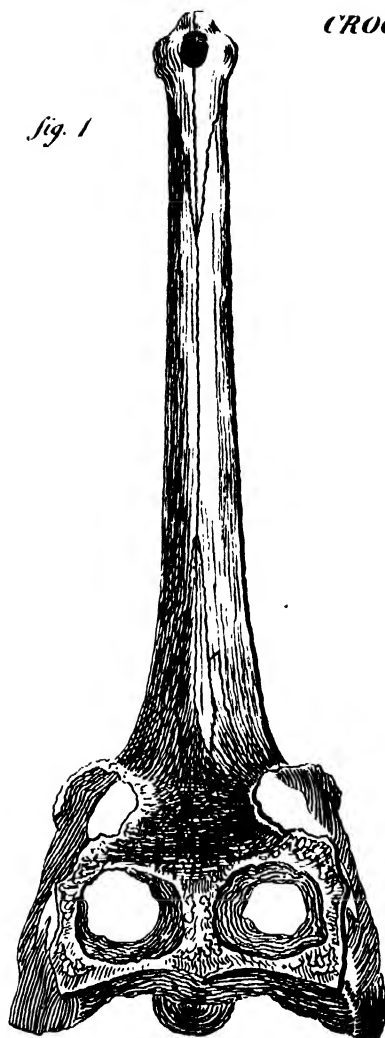
or a small 2' r. - smooth



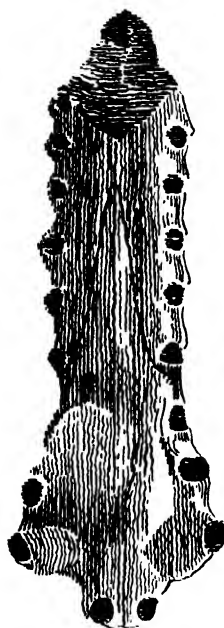


*CROCODILUS LONGIROSTRIS. the Charial.*  
*fossil and existing species  $\frac{1}{2}$ <sup>th</sup> scale*

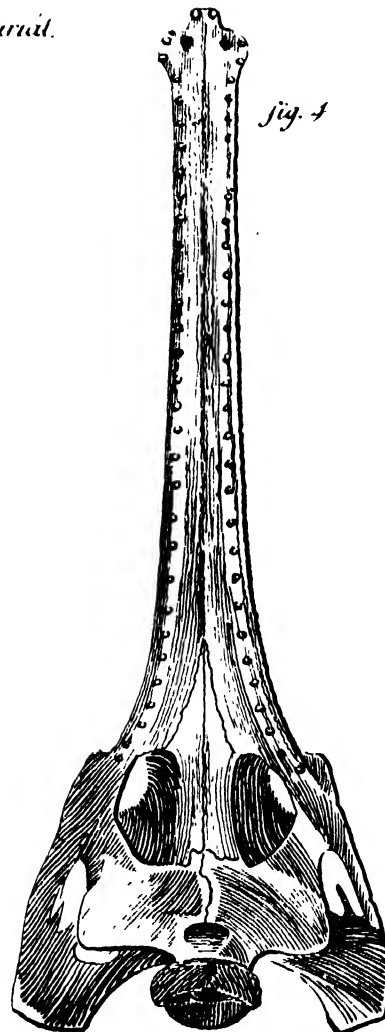
*fig. 1*



*fig. 2*

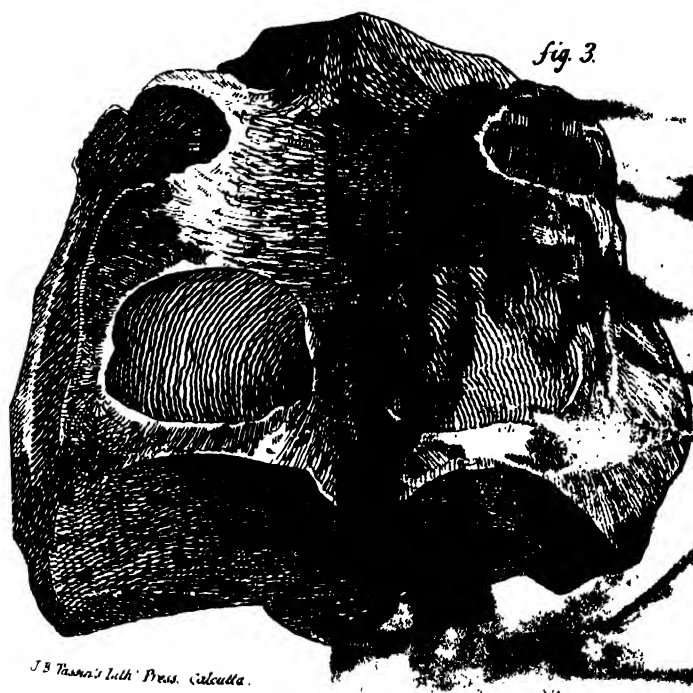


*fig. 3*

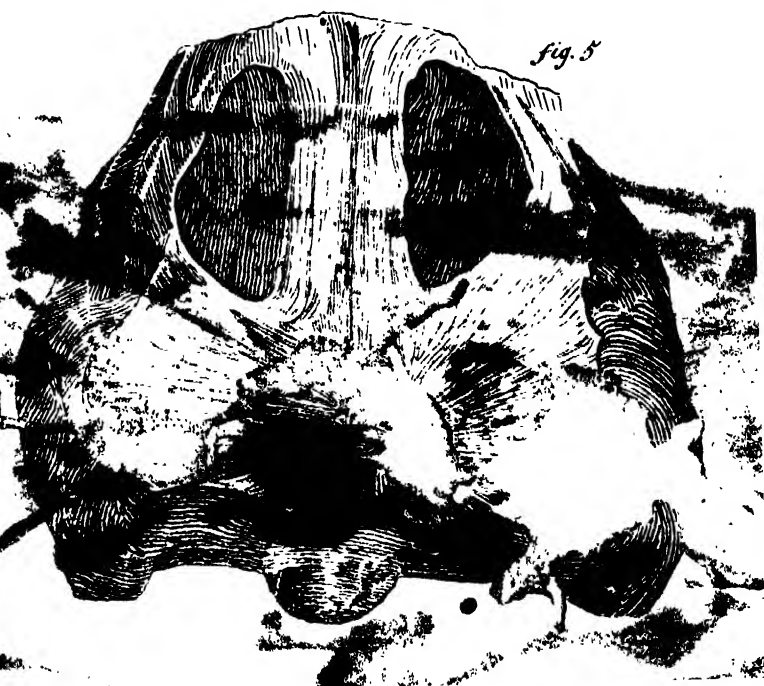


*1 upper view skull of existing Charial of 10 ft. 3 in*  
*3 under do*  
*2 beak of do. fossil.*  
*3 cranium of do*  
*under view of 10 ft. 3 in*

*fig. 3*



*fig. 5*





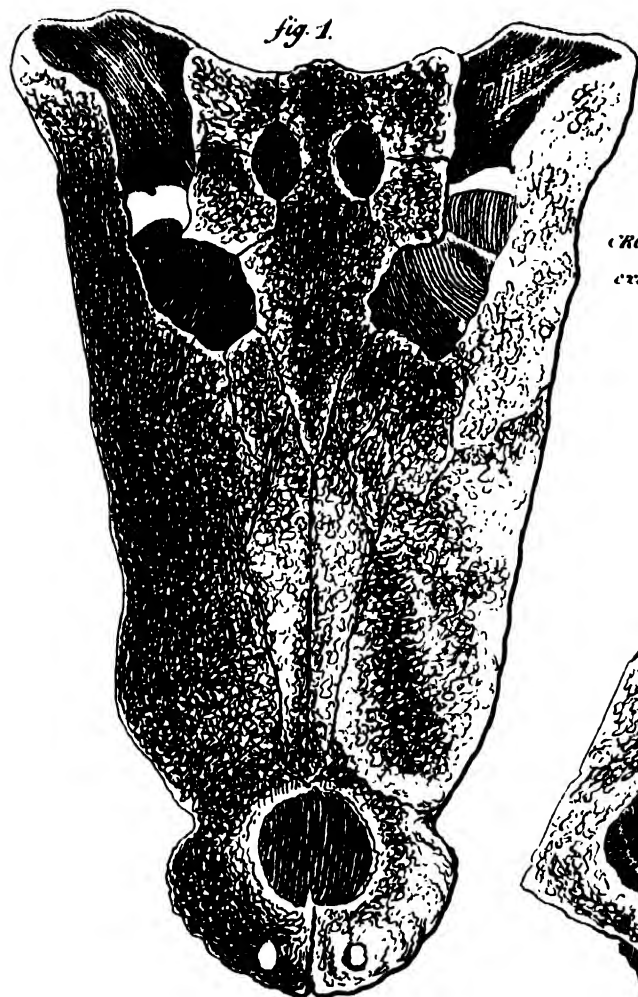


fig. 1.

*CROCODYLUS BIPORCATUS*  
existing species  $\frac{1}{4}$  in scale

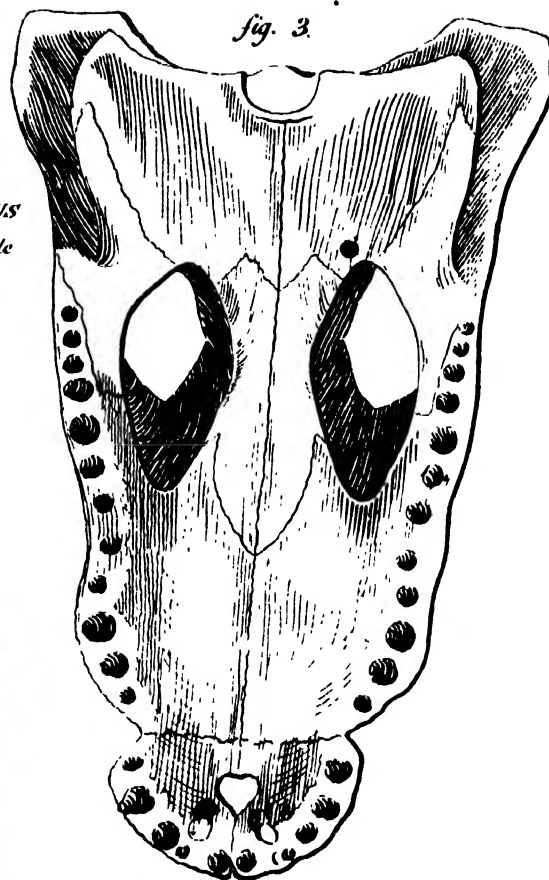


fig. 3.

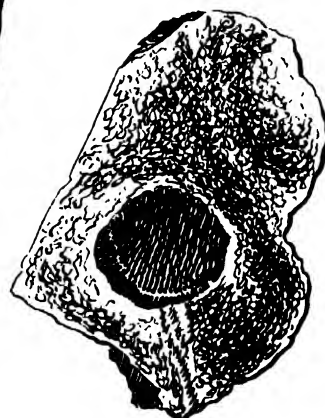


fig. 5.

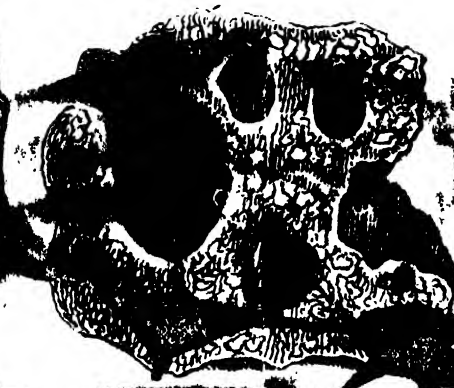
fig. 2

Fossil species: variety of *C. biporcatus*  $\frac{1}{4}$  in scale



fig. 4

fig. 6

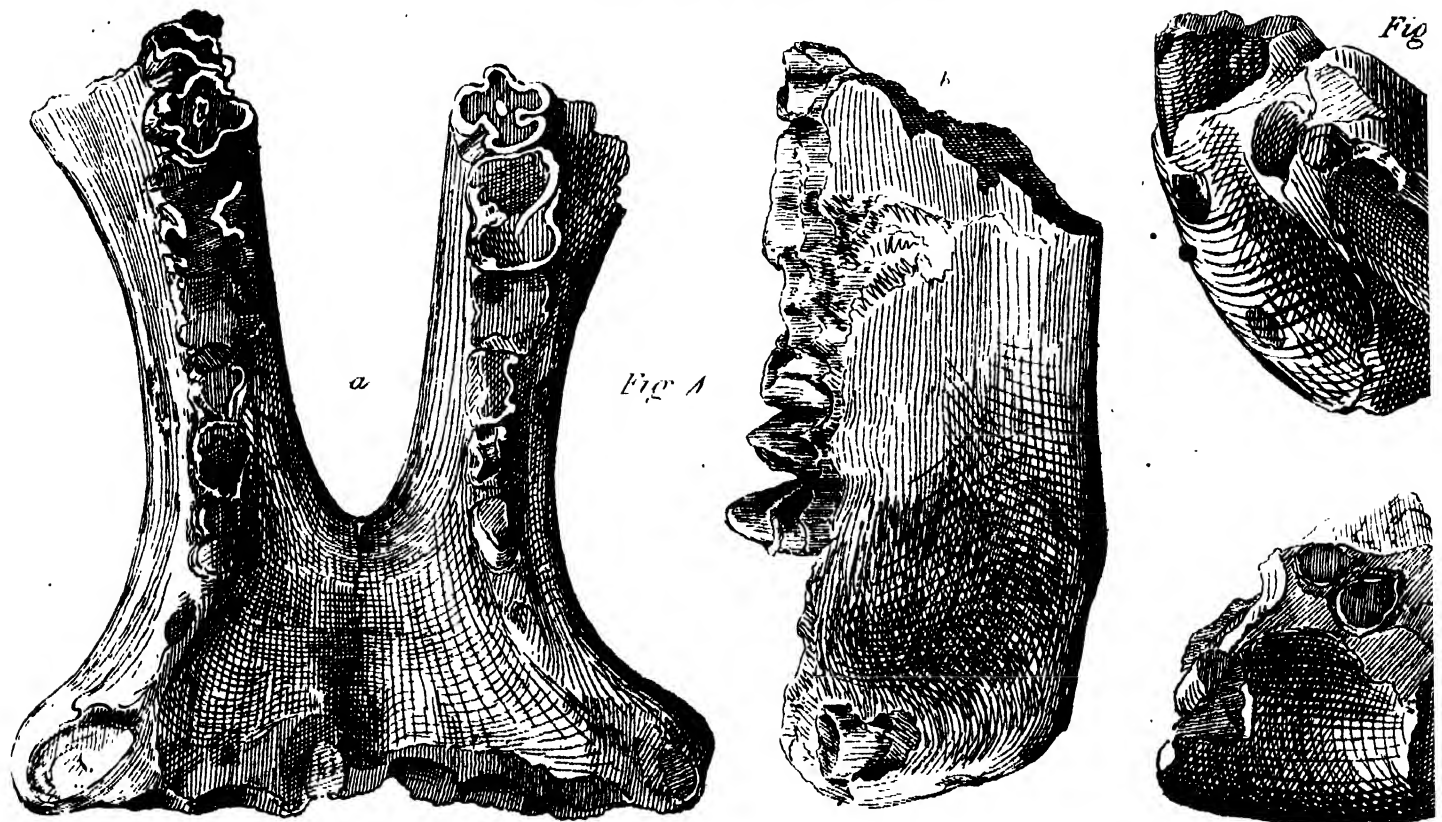


new species, fossil  
of *Crocodylus*



*Fossil HIPPOPOTAMUS of the Sub Himalayas.*

*Scale 3rd of natural dimensions*

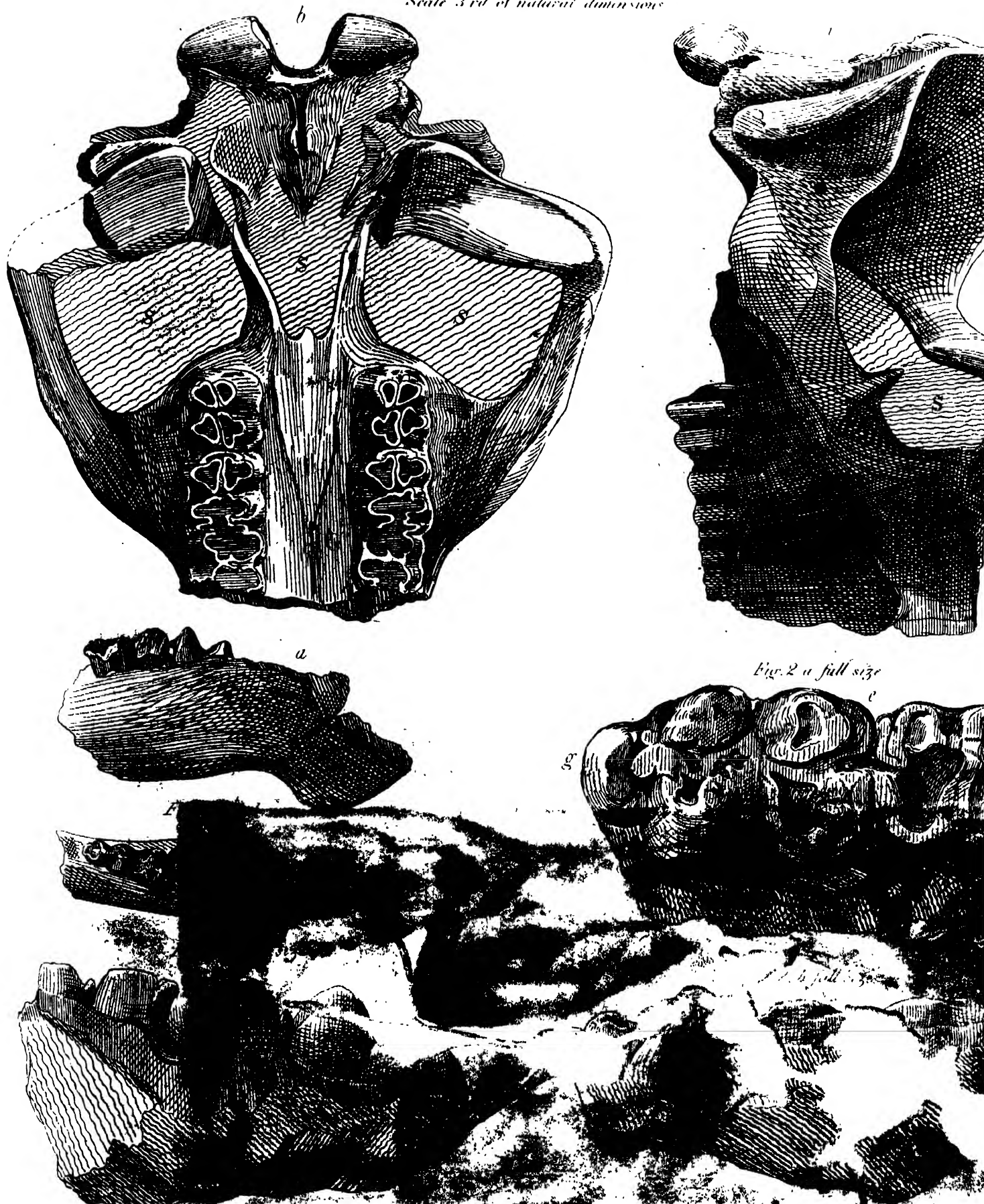




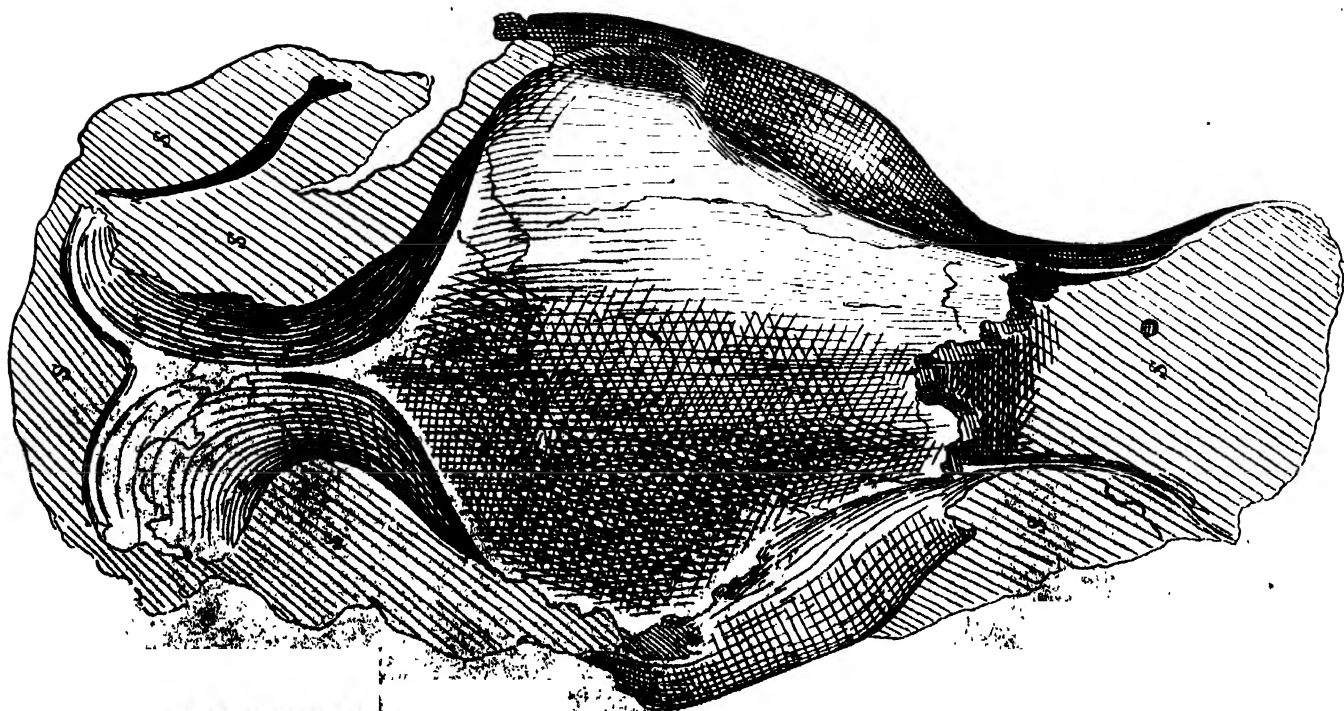


*Fossil HIPPOPOTAMUS of the Sub Himalayas*

*Scale 3rd of natural dimensions*









MISCELLANEOUS FOSSILS  
of the Sub-Himalayas.

Pla.

Fig. 9. a.

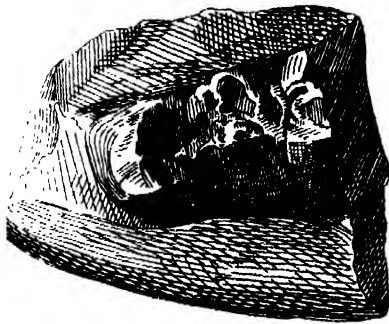


Fig. 10. a.

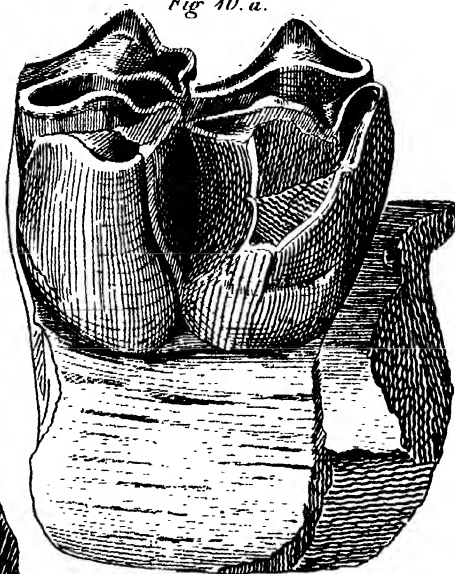


Fig. 10. b.

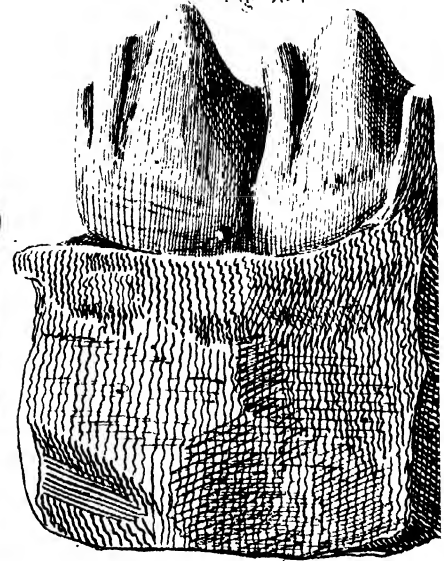


Fig. 9. b.

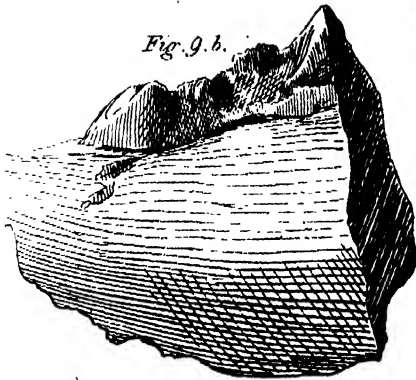


Fig. 7.

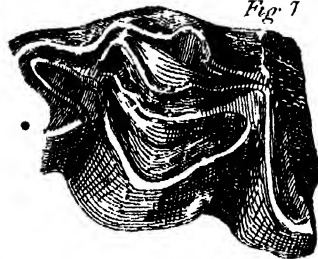


Fig. 12. a.

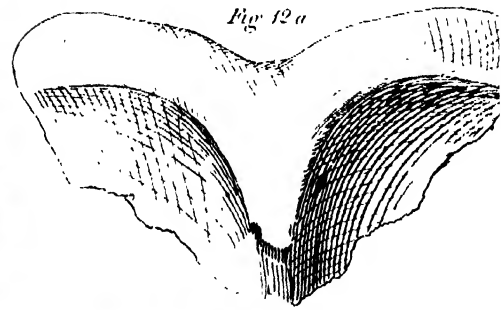


Fig. 9. c.

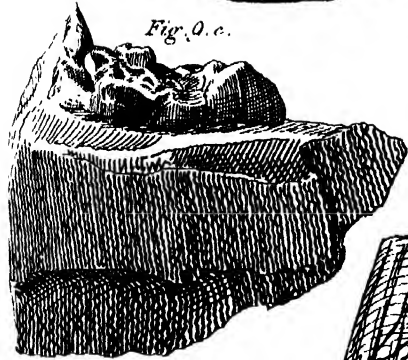


Fig. 11.



Fig. 8.

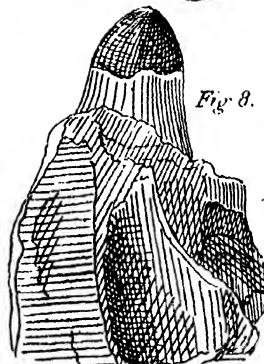
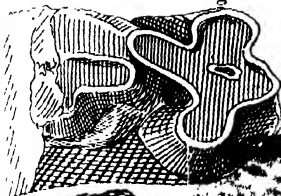


Fig. 12. b.

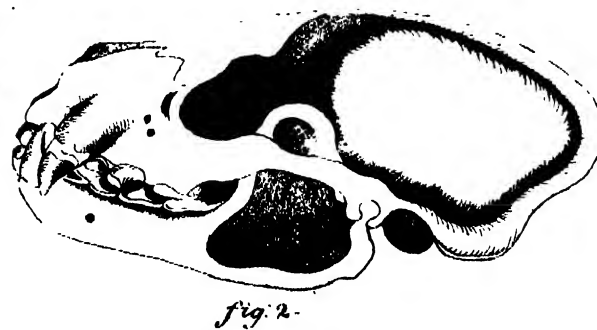


Fig. 6.



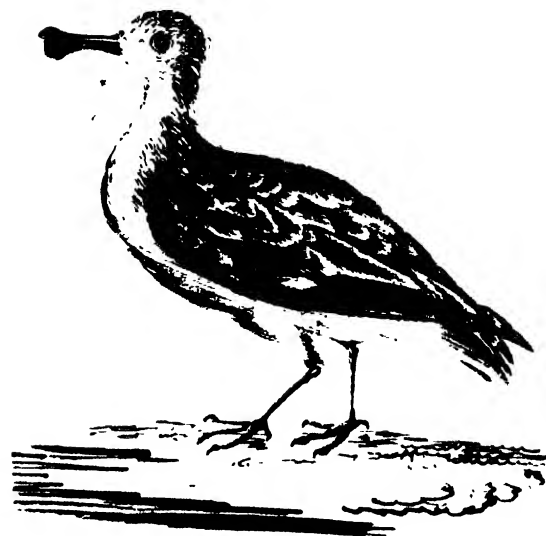
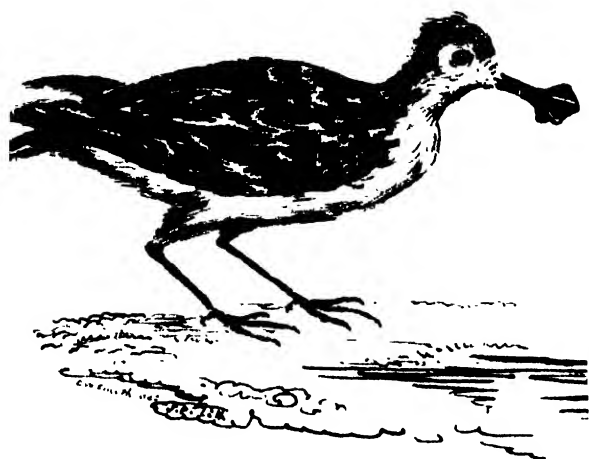










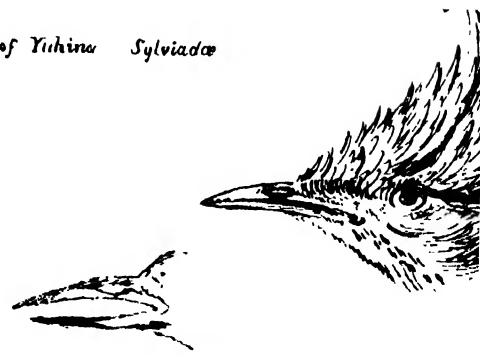
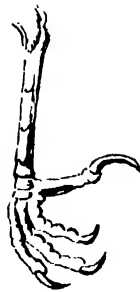


*Eurinyx alpestris*

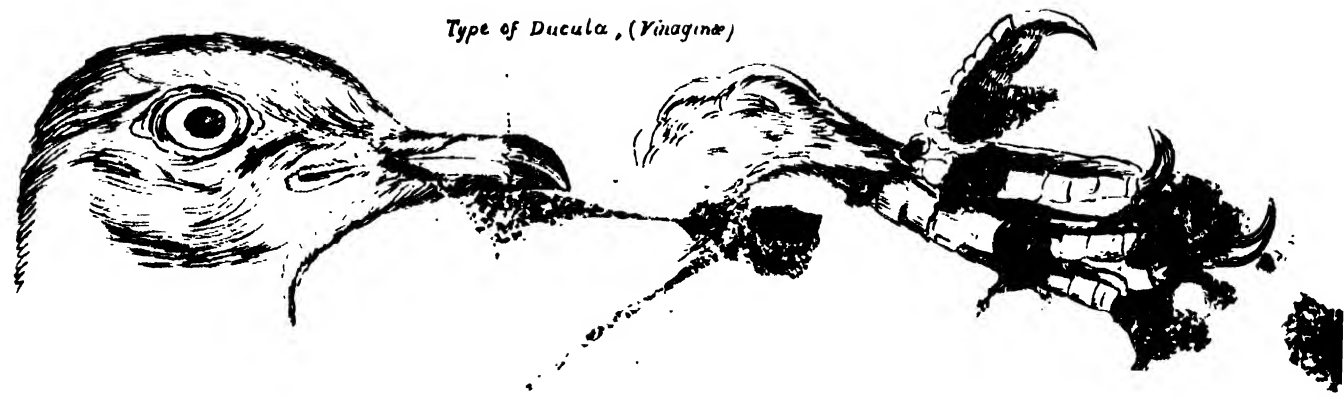
Type of *Troglodytes nipalensis*



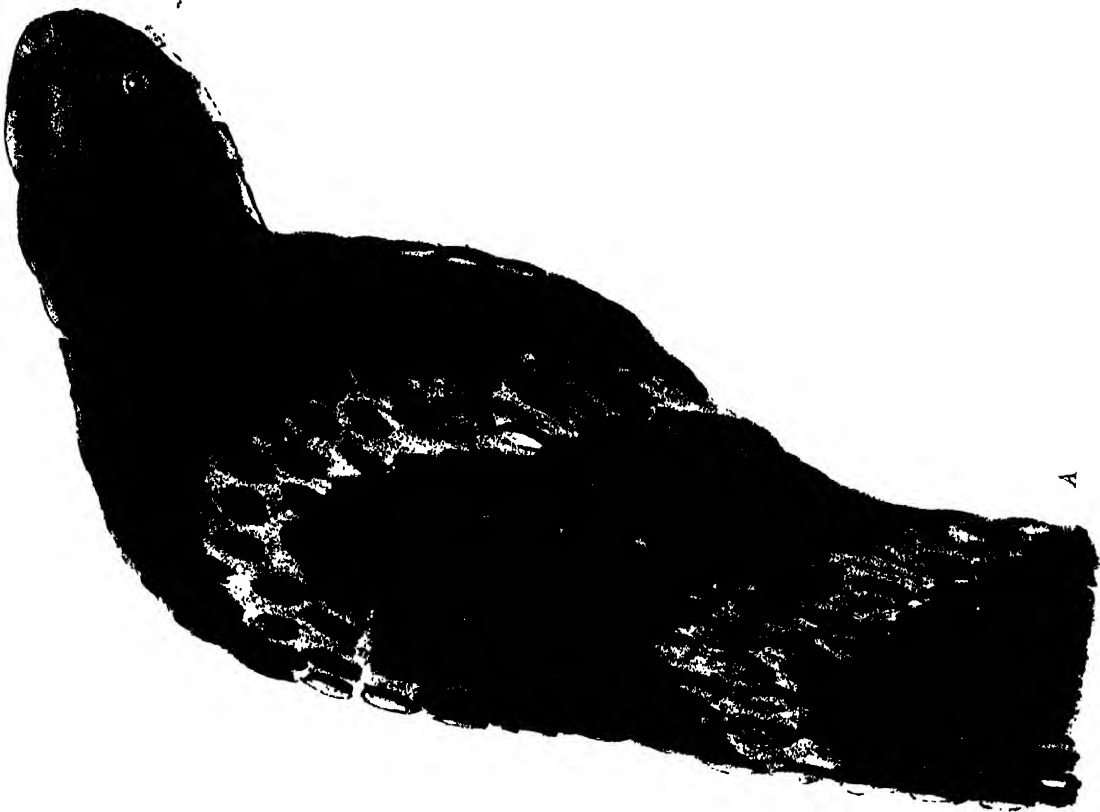
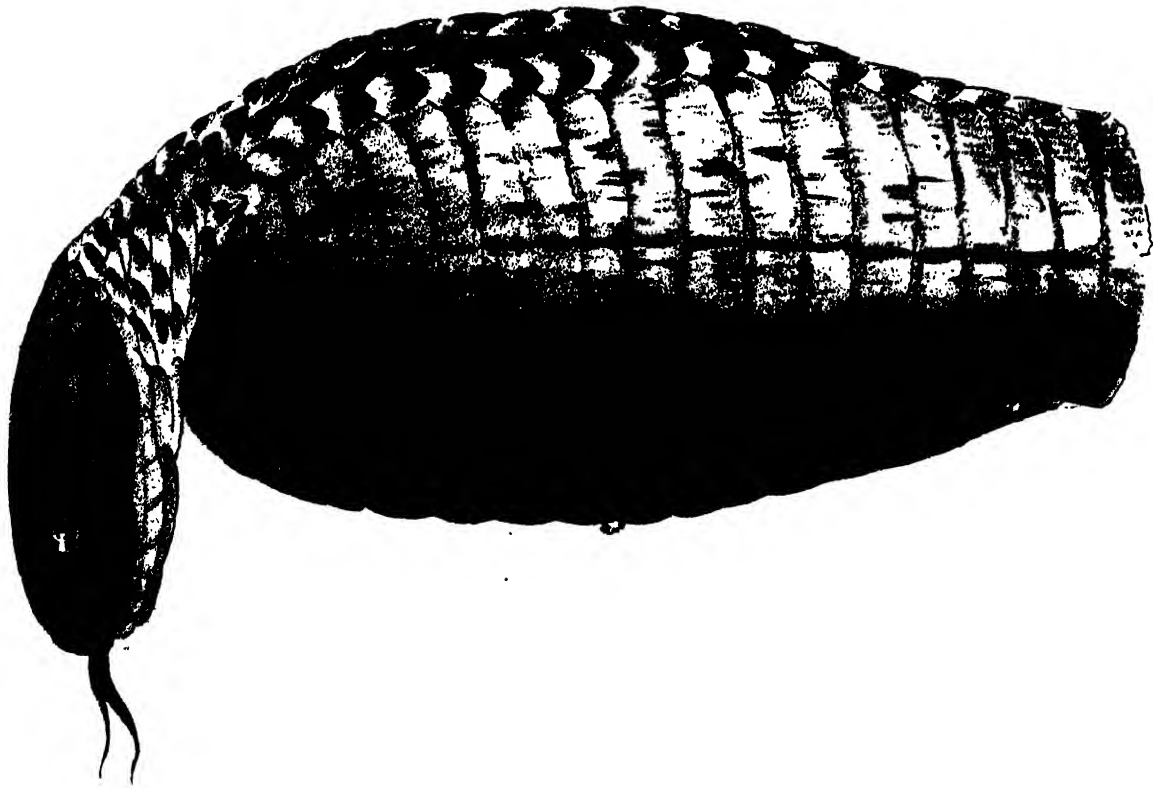
Type of *Yuhina sylvia*



Type of *Ducula*, (*Vinagins*)

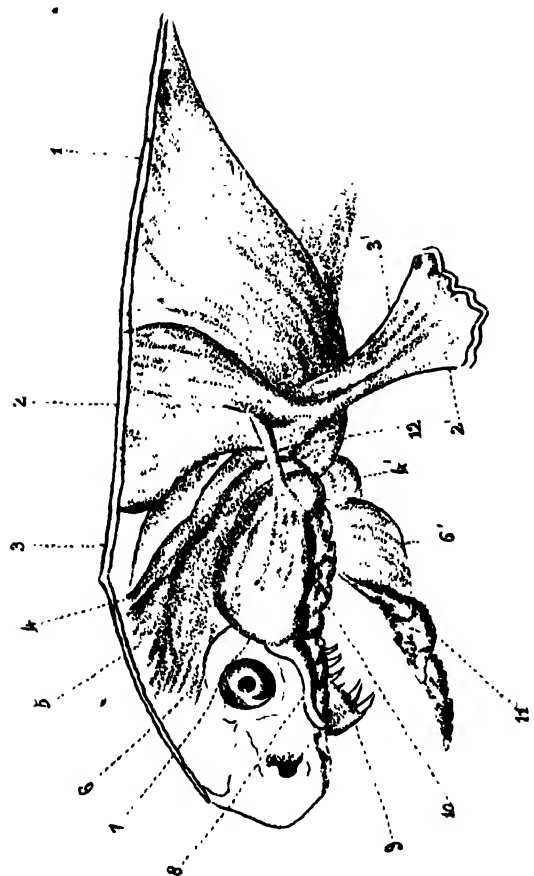




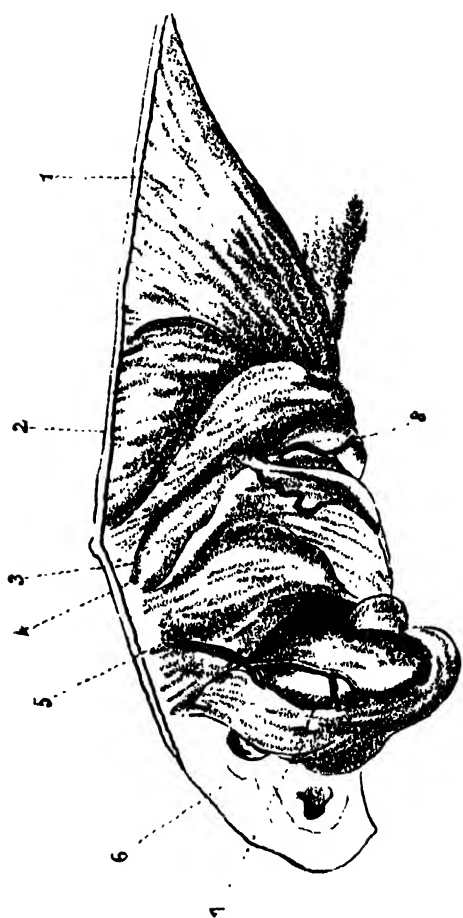


*HAMADRYAS HAMNAH.*

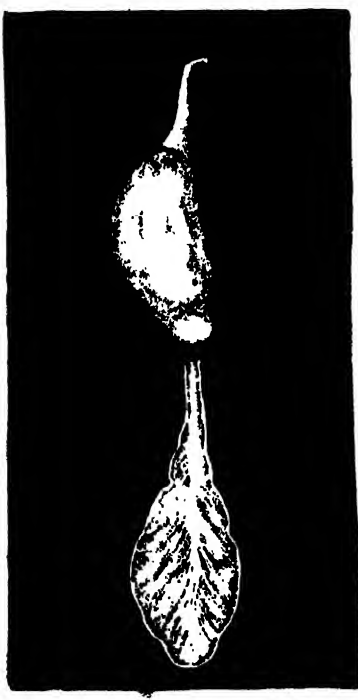




B

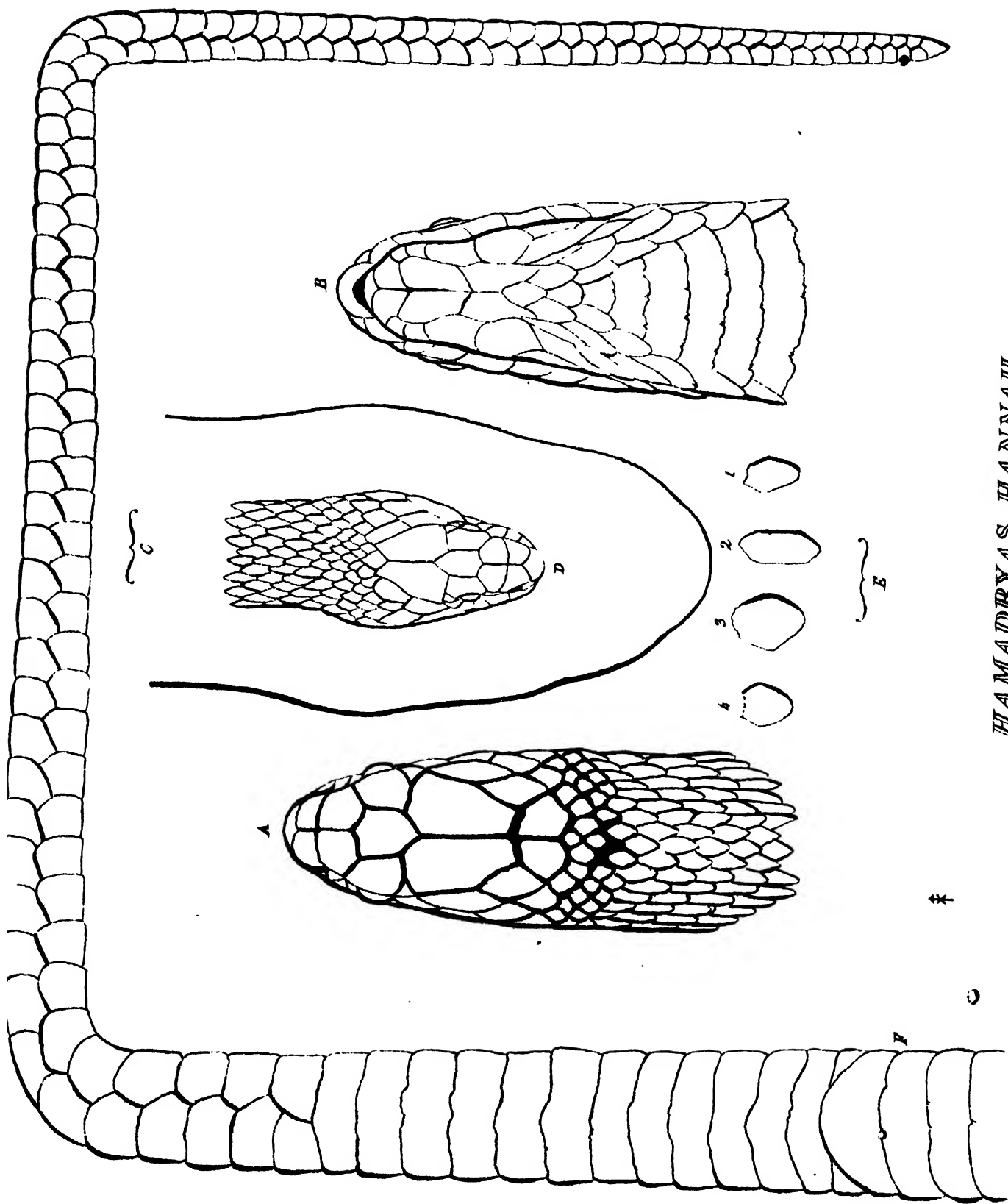


D



*HAMADRYAS HANNAHI*





*HAMADRYAS HANNAH*





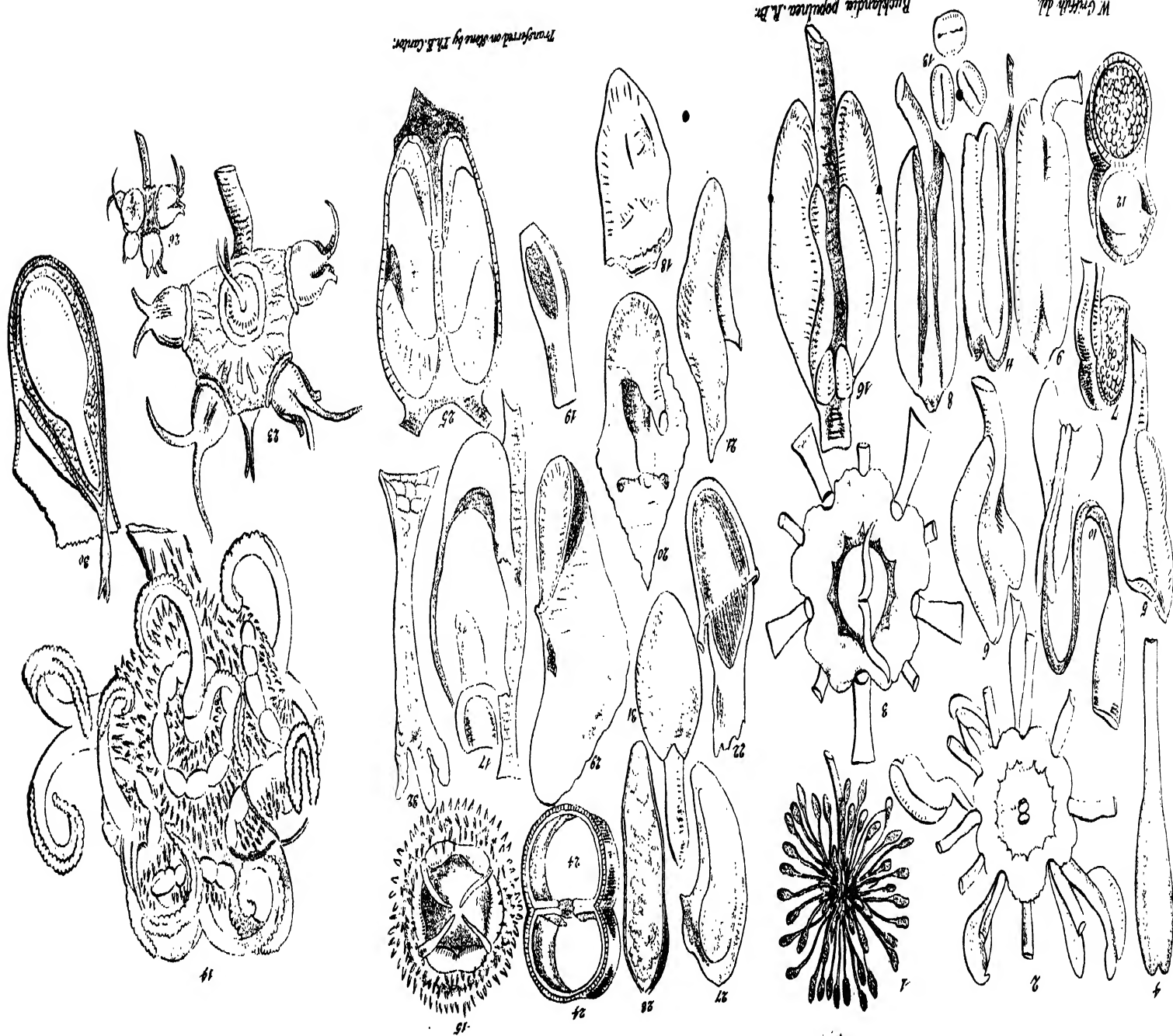
*Bucklandia populnea* Br.



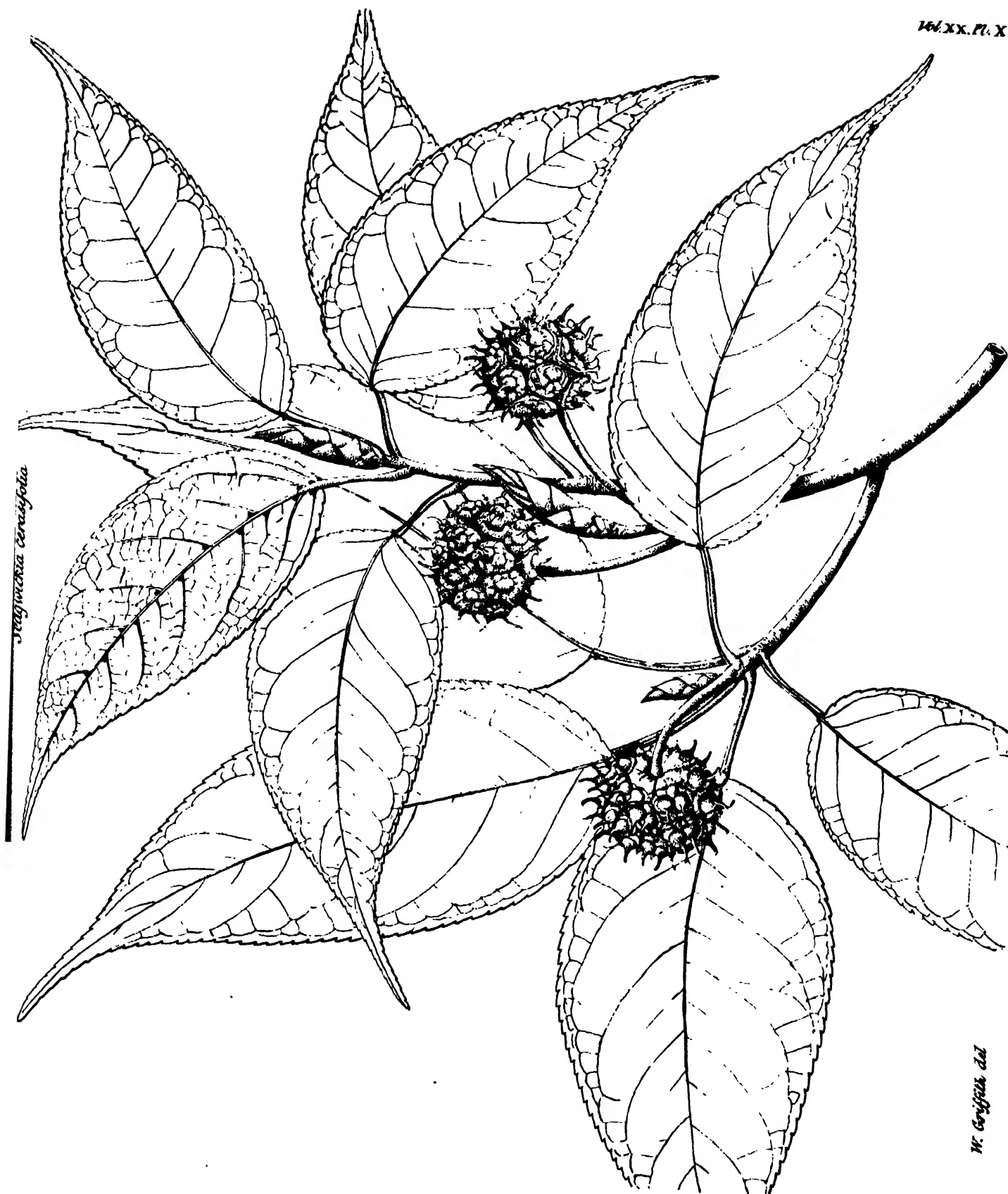
W. Griffith del.

*Buchlandia populnea*, A. Br.  
J.B. Smith 1844. Pres. Acad. Sci.

Transferred on Stone by Th. B. Carter.





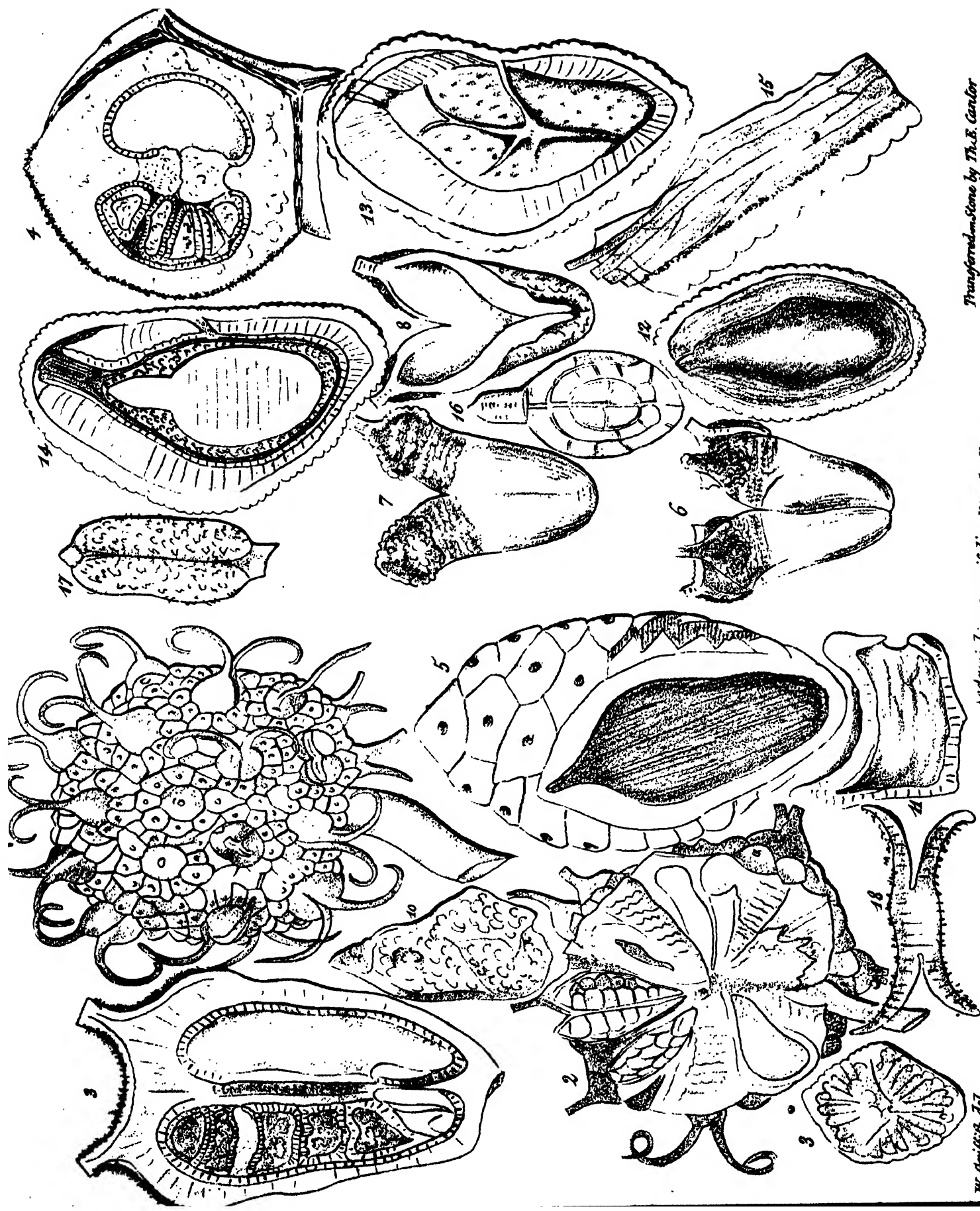


*Fraxinaria cernuifolia*

J.B. Thoreau 17.11.1857. Forest - Calcutta.

W. Griffith del.





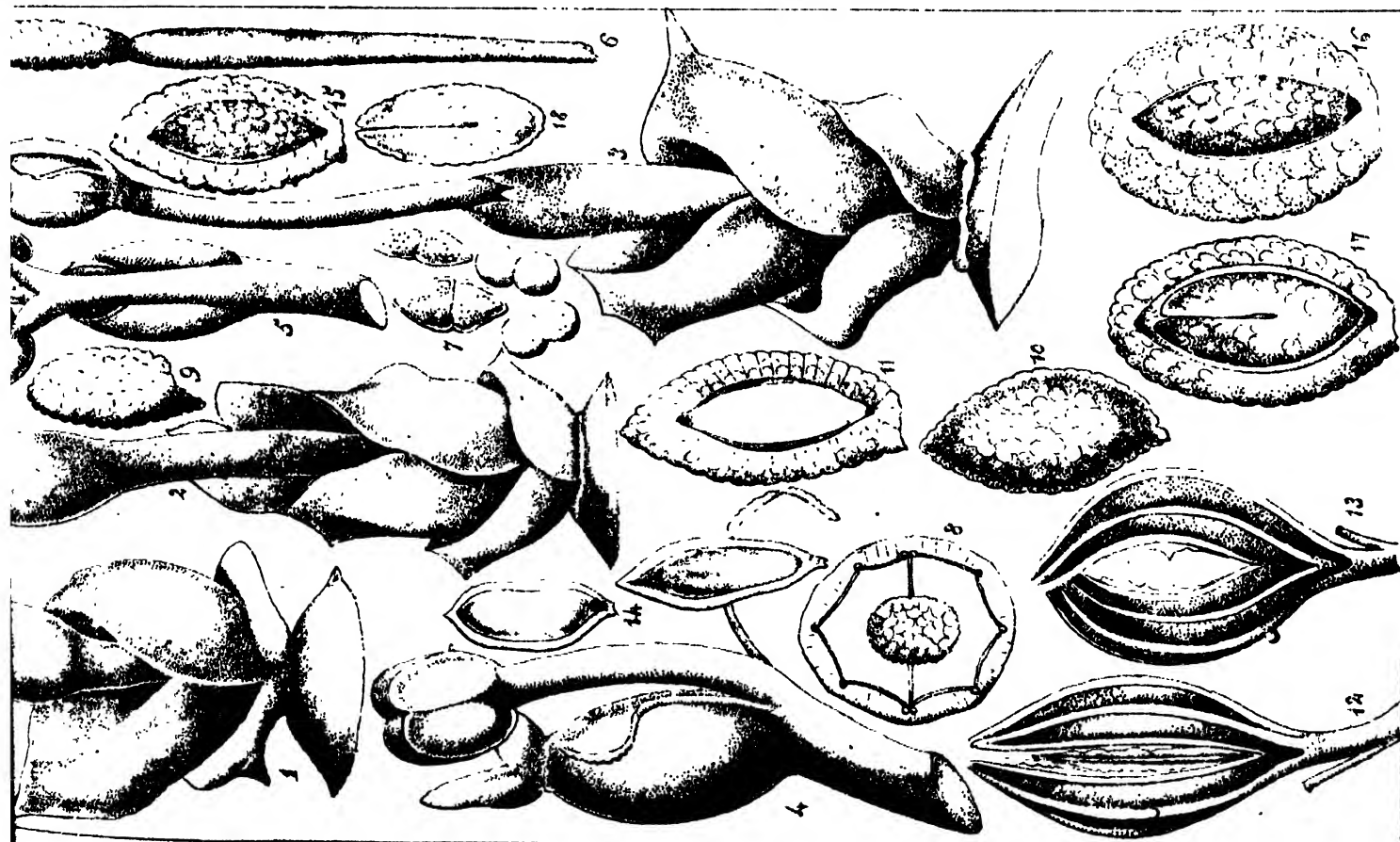
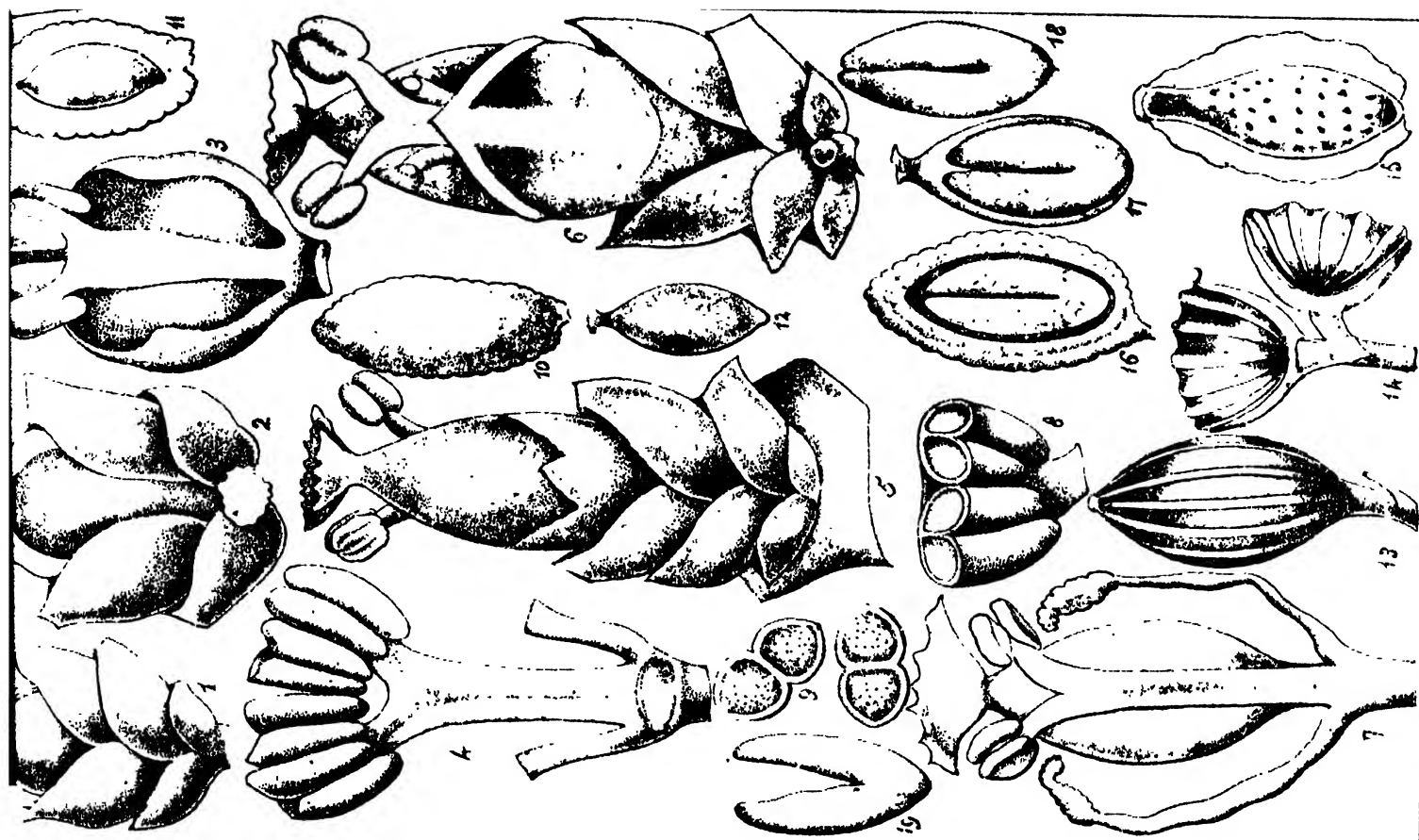
*Transferred from Stone by Th. E. Carter*

*Sedgwickia ceratophylla* W. & Gr. Mes.

W. Griffiths del.

















*CAMELUS SIVALENSIS*

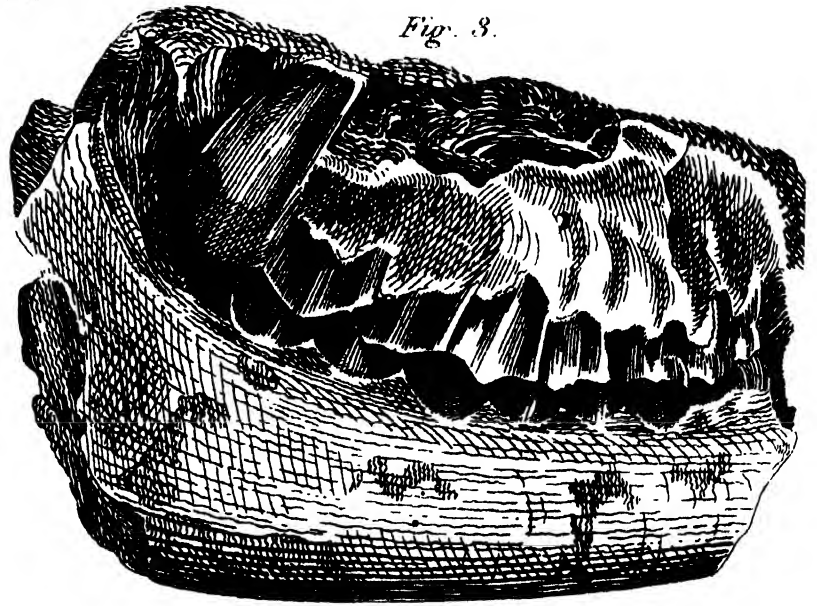
*2 linear dimensions*

*Plate XL*

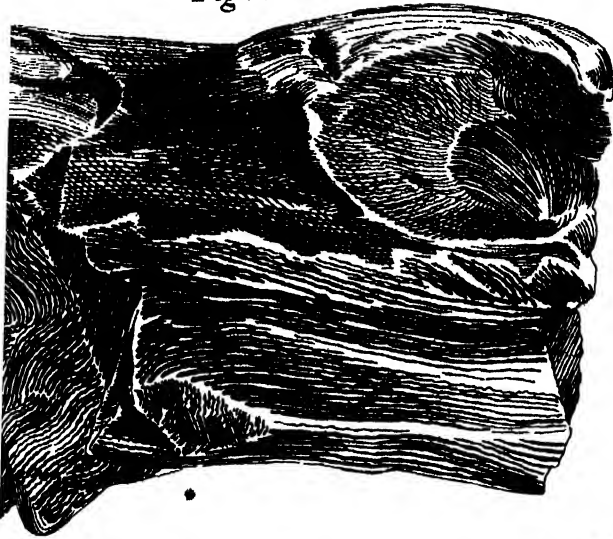
*Fig. 1.*



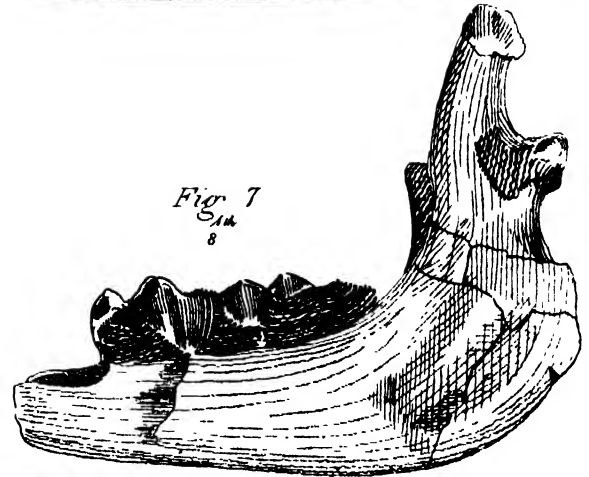
*Fig. 3.*



*Fig. 2.*

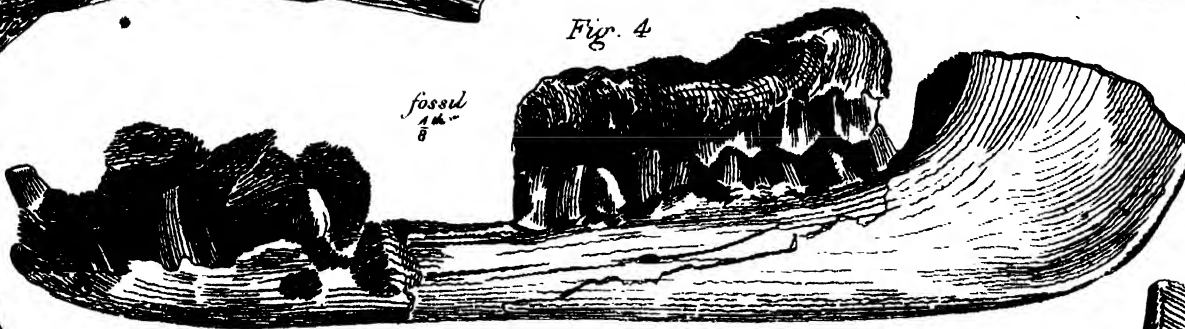


*Fig. 7*  
*5th*  
*8*



*Fig. 4*

*fossil*  
*1st*  
*8*

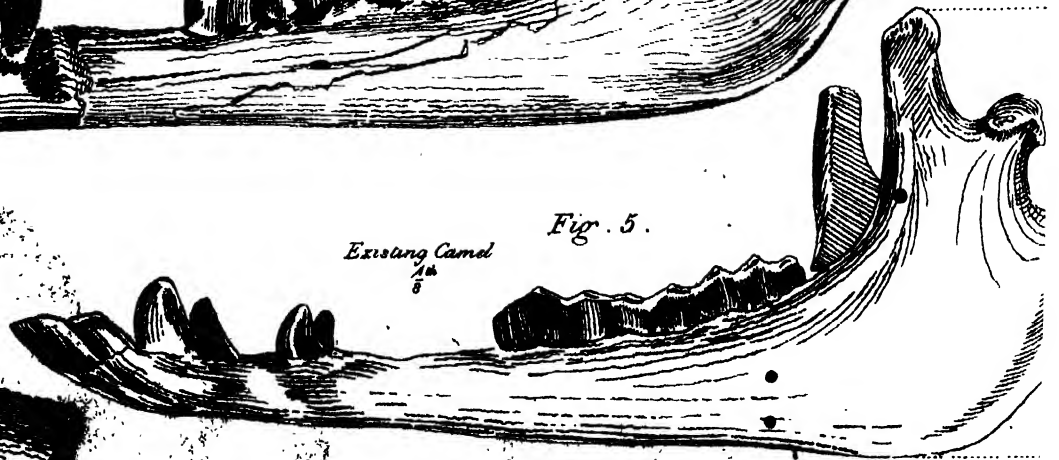


*Fig. 6.*  
*4th*



*Existing Camel*  
*1st*  
*8*

*Fig. 5.*





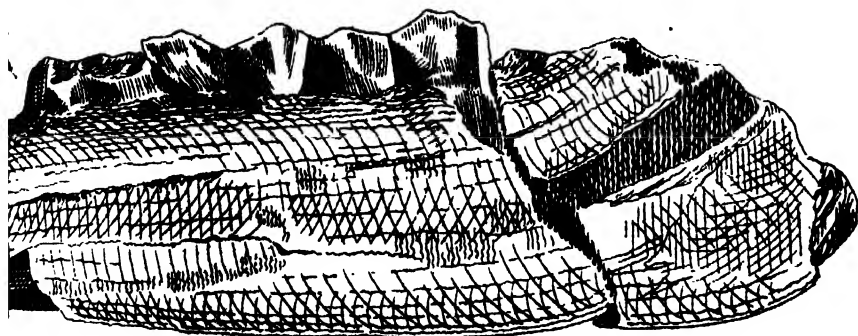


*CAMELUS SIVALENSIS*

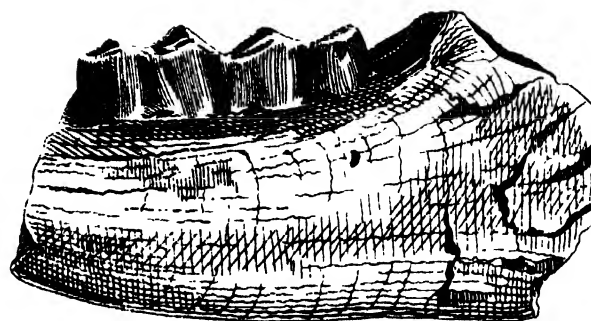
Plate

*Fig. 8*

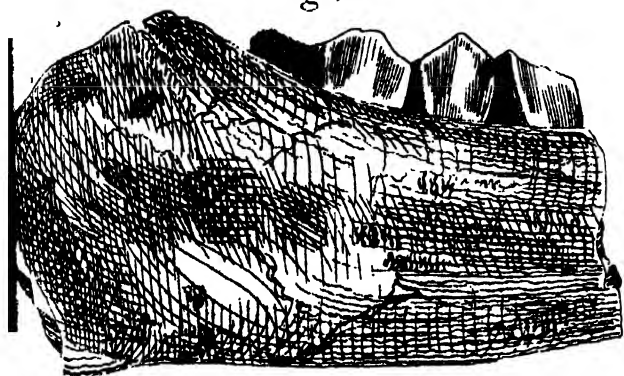
$\frac{1}{2}$  linear dimensions.



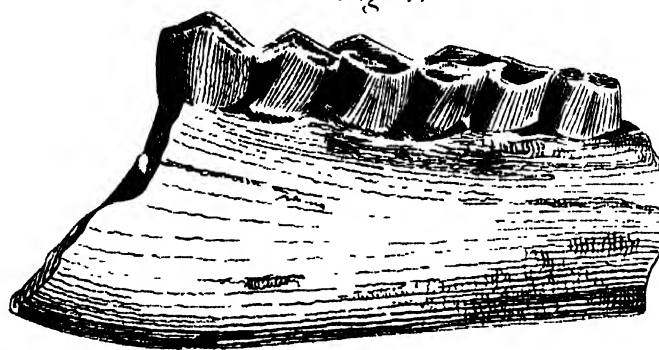
*Fig. 9*



*Fig. 10.*



*Fig. 11*



*Fig. 13.*



*Fig. 12.*



*FELIS CRISTATA*

$\frac{1}{3}$  linear dimensions

*Fig. 1.*



a

c

*Fig. 2.*

The shade denotes those parts covered with matrix





SECOND PART  
OF THE  
NINETEENTH VOLUME  
OF  
**ASIATIC RESEARCHES;**  
OR,  
*TRANSACTIONS OF THE SOCIETY*  
INSTITUTED IN BENGAL,  
FOR INQUIRING INTO  
THE HISTORY, THE ANTIQUITIES, THE ARTS AND  
SCIENCES, AND LITERATURE  
OF  
A S I A.

---

CALCUTTA:  
Bishop's College Press.  
1839.



CONTENTS  
OF THE  
SECOND PART OF THE 19th VOLUME.

---

*"Indian Cyprinidæ," by Mr. John M' Clelland, Assistant Surgeon; Member Asiatic Society,  
and Corresponding Member of the Zoological, and Entomological Societies of London. 217*

## Errata.

- Page 239, Line 8 from bottom, for *poliozus*, read *leucerus*.  
 Page 270, Line 11 from top, for *hetea* read *petea*.  
 Page 272, Line 7 from bottom,  
 Page 312, Line 12 from top,  
 Page 342, Line 11 from top,  
 Page 347, Last line. } for *diliciasus* read *deliciosus*.  
 Page 279, Line 5 from bottom, for *here* read *where*.  
 Page 281, Line 7 from top, for *rupiculus* read *rupicolus*.  
 Page 285, Line 13 from top, and second from bottom, for *pyropterus* read *pyrropterus*.  
 Page 292, Line 6 from bottom, for *rasobora*, read *rasbora*.  
 Page 298, Line 5 from bottom, for *widety* read *widely*.  
 Page 287, Line 12 from bottom, and  
 Page 290, Line 3 from top, and  
 Page 300, Line 8 from bottom, } for *diaphinous* read *diaphanous*.  
 Page 309, Line 1 and  
 Page 411, Line 13 from top, } for *rupecula*, read *rupicola*.  
 Page 314, Line 9 from top, for *pyropterus*, read *pyrropterus*.  
 Page 314, Line 6 from top, and  
 Page 373, Line 13 from top, } for *rupeculus* read *rupicolus*.  
 Page 315, Line 2 from bottom, for *Hormay* read *Hunnay*.  
 Page 336, Line 4 from top, and  
 Page 337, Line 11 from top, } for *hexagonolepus*, read *hexagonolepis*.  
 Page 312, Line 2 from top, for *B. progastus*, read *Oreinus progastus*.  
 Ditto, Line 17 from top, for *preceeded*, read *preceded*.  
 Page 344, Line 10 from bottom, for *Pl. 30.* read *Pl. 39.*  
 Page 398, Line 7 from bottom, for *macrouru* read *macrourus*.  
 Page 422, Line 8 from bottom, for *acanthopterus* read *latipinnatus*.  
 Page 452, Line 8 from top, for *lamyhur* read *lamghur*.  
 Plate XLV, Four *Perilamps* is by mistake marked *LVI*.  
 Plate LIX last figures right lower corner, for 13 read figure 14.

## Addenda.

- Page 220, Line 6 from bottom, omit, *Mirgul*, and insert the following species figured by Buchanan; *Cyprinus chola*,  
*Conchoniis*, *Jogia*, *Shakra*, *Barna*, *Vagra*, *Borila*, *Anjana*.  
 Page 291, Line 11 from bottom, after the words "dorsal and anal small," insert, "the former opposite to the  
 ventrals."  
 Page 299, Line 4 from top, after the words "intestine is short, and" insert, "the body"  
 Page 345, After *O. maculatus*, J. M. insert *Pl. 57. f. 6.*

I.

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INDIAN CYPRINIDÆ.

---

BY MR. JOHN McCLELLAND,

ASSISTANT SURGEON BENGAL MEDICAL SERVICE.

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Presented, 5th September, 1838.

DR. PATRICK RUSSELL published in 1803 an account of 200 species of fishes found chiefly on the coast of Coromandel; there appears to be no copy of his work in Calcutta, nor have I been able to meet with it in India; but his collection appears to have embraced few *Cyprinidæ*, and scarcely any of those afterwards found in Bengal by Dr. Buchanan.\* The fishes of Ceylon as well as those of the Bay of Bengal have recently excited the attention of naturalists,† while those of the Sunderbuns and the vicinity of Calcutta have long been objects of interest to collectors for the Museums of France and the other parts of the continent, where alone ichthyology seems to have been cultivated as a philosophical branch of zoology.

---

\* Afterwards Dr. BUCHANAN HAMILTON. As most of his publications have appeared under the name of Buchanan, authors should follow the example of Cuvier in the *Règne Animal* and *Histoire Naturelle Des Poissons* in referring to the author of the Gangetic Fishes by the name by which he is best and will be universally known, in proportion as his vast works on Indian statistics and Natural History transpire.

† Mr. Bennett and my friend Dr. Cantor.

2. Dr. Buchanan appears to be the only author who has devoted his attention to the fresh-water fishes of Bengal, and his success seems to have left little for others to do in the way of discovering new species. His *Gangetic Fishes*, published in Edinburgh 1822, contains descriptions of no fewer than eighty Cyprins, of which number he has only given figures of twenty-one. And unfortunately, Cuvier appears to have adopted such only as were figured in that work, leaving the rest as doubtful materials, which from their extent, and the deficiency of the details connected with them, perhaps deterred him from the task of entering into, or finishing, his account of the Carps in the hope of receiving further particulars regarding them from India.

3. It was partly with a view of supplying this deficiency that I devoted the time we spent on rivers during our\* journey to Assam in the winter of 1835-6, to the examination and figuring of species. The obscurity of Buchanan's specific descriptions, which with few exceptions are chiefly composed of characters of generic value, rendered the task of identifying his unfigured Cyprins most difficult and uncertain. Nevertheless it appeared to me to be a desideratum that must be accomplished sooner or later by some one, and at length, after perseverance for the better part of three years, occasionally giving it up in despair, I succeeded in identifying most of the species unfigured by Buchanan, as well as in having made two series of finished drawings of them, one set for England and one for India. After all this, and after the present paper had been ready for publication in April last, my notice was for the first time attracted by a remark of Buchanan, in consequence of which I thought it necessary to make inquiry for certain drawings alluded to *Pisc. Gang.* p. 316. I had heard of drawings at the Botanic Garden, but never saw them; and always supposed them to be merely the originals of published figures; but I confess I was quite unprepared to receive at that time a collection of drawings from Dr. Wallich

---

\* I allude to the deputation of Dr. Wallich, Mr. Griffith, and myself to Upper Assam.



amounting to 150 beautifully executed, and including nearly all the unpublished species on which my painters had been so long employed, with the specific names in Buchanan's hand-writing marked under the figures, so as to leave no doubt or difficulty in referring them to corresponding descriptions in the Gangetic Fishes. I am not prepared to state how many unfigured species this interesting collection contains, except in the particular family which is the subject of this paper. Along with these drawings I received intimation from Dr. Wallich that two folio volumes of manuscripts and drawings on general zoological subjects by the late Dr. Buchanan still remain at the Gardens. The descriptions alluded to may probably serve as a key to Hardwicke's Illustrations, into which I perceive several figures of *Cyprinidæ* have been accurately copied except in the colouring, from Buchanan's drawings; and as no descriptions of the plates of Hardwicke's work have been yet to my knowledge published, the source from whence the figures in question came does not transpire, and there is no allusion to it on the plates; at any rate it is unfair to General Hardwicke as it is to Dr. Buchanan, and to all who are engaged in pursuits connected with the Natural History of this or any other country, to have the unpublished works of any man shut up for twenty-two years in a library that is not open to the public.\*

---

\* Buchanan's Researches regarding the fishes of India commenced on his arrival in the country in 1794, and ended with the publication of the Gangetic Fishes in 1822. Anything that tended to lessen the value of a work that occupied so much of such a life is to be regretted. It is stated in a biographical notice of Buchanan in Chamber's Lives of Scotchmen, that on his departure from India he was deprived by the Marquis of Hastings of all his extensive drawings and papers relating to every branch of Natural History, *particularly Botany*, "although to me," quoting his own words to the Edinburgh Philosophical Society, "as an individual they were of no value, as I preserve no collections, and have no occasion to convert them into money, but I was merely desirous of seeing them safely deposited in the India House." In deciding that Buchanan's papers should be retained in India, it may be presumed that the object was that they should here be rendered more useful to the country than they could be in England. It could scarcely have occurred to the Marquis of Hastings that these works would be consigned to oblivion and the author in consequence superseded by his successors.

The following are the names of the unpublished figures of *Cyprinidæ* in this collection of drawings.\*

Cyprinus	Gugani, Buch.	Cyprinus	Bangana, id.
_____	Gorachela, id.	_____	Pangusia, id.
_____	Joya, id.	_____	Sarana, id.
_____	Cachius, id.	_____	Kunta, id.
_____	Loubuca, id.	_____	Tor, id.
_____	Phula, id.	_____	Sada, id.
_____	Bhola, id.	_____	Lati, id.
_____	Gora, id.	_____	Gohama, id.
_____	Borelio, id.	_____	Godeyava, id.
_____	Rerio, id.	_____	Dheno, id.
_____	Dangila, id.	_____	Jaulyali, id.
_____	Balibola, id.	_____	Paungsi, id.
_____	Bukrangi, id.	_____	Bimaculatus, id.
_____	Loya, id.	_____	Sucatio, id.
_____	Phulchela, id.	_____	Balitora, id.
_____	Titius, id.	Cobitis	Gongota, id.
_____	Terio, id.	_____	Balgara, id.
_____	Sutiha, id.	_____	Cucura, id.
_____	Phutunio, id.	_____	Guntea, id.
_____	Gelius, id.	_____	Botea, id.
_____	Kanipunte, id.	_____	Pangia, id.
_____	Casuatus, id.	_____	Biltura, id.
_____	Cursis, id.	_____	Turia, id.
_____	Cursa, id.	_____	Scuturiginum, id.
_____	Mirgul, id.	_____	Savona, id.
_____	Bata, id.	_____	Corica, id.

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\* But although they seem to have been withheld from Buchanan himself, the following drawings from his original collection of unpublished figures of fishes have found their way from the Botanic Garden into Hardwicke's Illustrations, without any acknowledgment to point out from whence they were derived.

4. An examination of the viscera connected with the digestive organs together with the form of the mouth, suggested the possibility of identifying

Tab. 84. *Hypostomus sisor*, Buch. *Sisor Rabdophorus*, id. *Gan Fis.* two drawings.

T. 85. *Malopterus Kazali*, Buch. Two figures; name changed to "*Malopterus (Ailia) Benga-lensis*" Gray, in the pirated figures.

T. 86. Fig. 1. *Cyprinus angra*, Buch. Pirated figure disguised under bad colouring, and named "*Cyprinus Hamiltoni*" Gray. Fig. 2. *Cyprinus goha*, Buch. Colouring much exaggerated. There are two figures of each species, so that this plate has been taken wholesale from Buchanan.

T. 87. Fig. 3. *Cyprinus chedra*, Buch. A good copy of a very beautiful drawing in Buchanan's collection.

T. 89. Fig. 1. *Syngnathus carce*, Buch. (Kharke id. orig. draw.) Note—an error in spelling the generic name of this species as written by Buchanan on the original drawing, is preserved in the pirated copy. Fig. 4. *Syngnathus deokpata*, Buch.

T. 91. Fig. 1. *Mystus chitol*, Buch. Colouring much exaggerated in the pirated copy.

T. 93. Fig. 1. *Cyprinus mosal*, Buch. Two figures, and two of *Cyprinus morala*, id. The coloured copy of this last is so badly executed that the characteristic marks of the species, though well depicted in the original by the obscure transverse streaks crossing the sides, are quite omitted in the copy.

T. 94. Fig. 1. *Cyprinus tileo*, Buch.

T. 95. Fig. 1. *Ophisurus boro*, Buch. The species is referred to Buchanan's manuscripts, but nothing is said to point out from whence the drawing was obtained, but it is so accurately traced from Buchanan's original, as to remove any doubt on that score. Fig. 2. *Ophisurus harancha*, Buch. By mistake on the part of the plagiarists in numbering the figures, the details of the first, are given to the second species. Fig. 4. *Muræna railaborua*, Buch. disguised under the names of *Rataboura "Hardwickii"* Gray; thus not only depriving Buchanan of the honor of figuring, but also of naming a new species. As an instance of the little reliance to be placed on those who thus appropriate the works of others, it is necessary to observe that the outline figure representing the lower parts of *Muræna railaborua* is transferred to *Ophisurus bora*, in return for that of the last having been given on the same plate to *Ophisurus harancha*. In other plates not numbered, forming 19th and 20th parts, are pirated as follows;

something on which the natural arrangement of fishes might be founded. In those Carps whose mouths are constructed for the collection of vegetable

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*Holocentrus*? *Kalkaya*, B. MS. two figures name changed to 'Pterapon Trivittatus'. *Cottus chaka*, B. MS. name changed to 'Platycephalus chacca', marked 'Natural size'. *Checlodipterus Bhutibue*, B. MS. name changed to 'Checlodipterus Butis', and the species referred to 'Hamilton', but nothing said of the source of the two figures. *Cyprinus morar* B. MS. two figures and *Cyprinus gora*, B. MS. forming an entire folio plate, the name of the latter changed to 'Cyprinus cora'. *Clupanadon chapra*, B. MS. pirated figure called 'Alosa chapra N. Indian Ocean', what the latter terms mean I cannot say, as the figure is from Buchanan's unpublished drawings of Gangetic species; like the remark 'natural size', annexed to *Cottus chaka*, it is certainly calculated to impress the reader with the belief that the author had seen the specimens from which the drawings were made. Neither of the remarks in question appear on the original drawings, which are characterised in Buchanan's hand writing.

Buchanan died in 1829. The work to which so much of his labour has been transferred was published in 1833, and although no descriptions of the plates have yet appeared, it is no excuse for having suppressed the source from whence so many of them at least were derived, especially, when it was thought necessary to acknowledge the source of other figures in the same work. These circumstances induced me to visit the Botanic Garden, with a view of ascertaining if all the other plates in Hardwicke's Illustrations, as well as those of fishes, were derived from the two folio volumes stated to be in the Library of that Institution. The following memorandum which was made on the occasion, must be interesting to all who are in any way connected with zoological pursuits.

" Botanic Garden, 3d September, 1838. Having obtained the requisite permission, I inspected Buchanan's Zoological MSS., for the first time;—they seem to contain descriptions and figures of the following animals:—

" Five species of *Simia*, one recently described by Dr. Harlan, in the American Phil: Transac: as *Simia Hoolook*.

" Five species of *Felinæ*, one gray above and spotted beneath, and a *Felis leopardus albus*, an *Ursus*.

" Six *Cervidæ*; a *Cervus niger*, Buch. Several species of *Mus*, two bearing Buchanan's specific names, also an *Ichneumon* and a *Hysterix opeigura*, Buch. three species of *Capra* bearing his specific names, as well several species of *Tortoises*, two species of flying *Foxes*, two *Lacertæ*, and two *Paradoxuri*.

food, I found, as might be expected, the greatest development of intestinal canal; in these the mouth is invariably either horizontal or directed downwards, as in the Cirrhins; all such types I have included under the head of *Pæonominæ* or herbivorous Carps, of which the Gudgeons and Gonorrhynchs are the most remarkable.

5. In the last mentioned genera the mouth is situated completely under the head, and is constructed in the Gudgeons for bruising soft vegetable

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“Of birds, I observed about sixty species of *Falconidæ*, about 150 *Insectores*, and about 74 *Grallæ*, including many rare *Tantalidæ*, and the species of *Ciconia* recently described as *C. cristata*, which appears to have been named nearly 30 years ago by Buchanan *Ardea crinita*; all which, in addition to the fishes, are drawn in duplicate, thus amounting to about 900 drawings.” Although Buchanan was professedly a botanist, his researches appear to have extended to all branches of natural history except entomology. His volumes on Gangetic Fishes, published at his own expense, under the disadvantage of being deprived of the greater part of his figures, are the only part of his zoological labours that are known, yet his inquiries in other branches of zoology were equally extensive, and equally intitled to publicity. It now appears that two quarto volumes of MSS. written with his usual erudition, have been retained in the Library of the Botanic Garden since 1815, while every periodical that has since appeared deprived him of some portion of those claims to priority which his papers ought to have secured to him had they been placed in proper hands, or deposited in an institution where their existence could have been known or appreciated.

Had such an injury to the advancement of information resulted from an oversight in an ordinary public office, the circumstance would excite less surprise; but that the works of a naturalist should be so treated in a public Institution expressly intended for the promotion of science, is so unaccountable to me, that I cannot presume to express an opinion on the subject. But as the case stands, perhaps the best remedy that can now be applied in justice to Buchanan, as well as to others who are still engaged in scientific pursuits, would be to give a complete edition of his labours, botanical and zoological, to the public, at the same time it is right to say that no atonement can now make amends for the injury that has been inflicted on Buchanan as a naturalist, or for the time that has been lost in allowing others to go over unnecessarily the ground which he investigated, instead of beginning where he left off.

substances, such as are found in stagnant waters, and in the Gonorhynchs for tearing and uprooting certain kinds of confervoid plants, which form a short slimy covering to the rocks on which they grow in clear mountain streams.

6. The true Cyprins (*Cyp. proprius* Cuv.) together with the Barbels, Cirrhins, and Labes, subsist less exclusively on a vegetable regimen. Their mouths are invariably small, and either directed downward or situated low in the head; and as far as my inquiries have extended, it is on such modifications of the mouth that we find the length of the intestines and the habits of the different groups to depend.

7. In the Gudgeons the mouth is formed simply for receiving a kind of food that is obtained in abundance without any effort, and which requires no prehensile teeth or other organs for its collection or preparation before it is submitted at once to the process of digestion. The mouth is consequently small, and is opened and closed chiefly by the muscular structure of the snout; the jaws are weak, and the lips hard and cartilaginous, without sensibility or muscularity, and their intestinal canal varies from eight to eleven and even twelve lengths of the body, including the head and caudal fin; except in the *Hypostomi*, Lacep. among fishes, Ostrich among birds, and perhaps some of the ruminants, such development of the abdominal canal is rare, a circumstance which it will be necessary afterwards to recollect when speaking of types.

8. In the Gonorhynchs the muscular power of the snout is greater than in the Gudgeons; the mouth is smaller and situated farther back in the lower surface of the head, the lips thicker, and though defended externally by a hard insensible cartilage, are formed for very powerful muscular action. In this genus the length of intestinal canal is usually about eight lengths of the body, and exceeds that of all other Cyprins except the Gudgeons.

9. The development of the intestinal canal in *Cyprinidæ* differs with the habits of species, so as to afford something like a basis for true distinctions between the different genera, and is fortunately connected with such peculiarities of form and colour, as to render it easily available as a guide to an improved method of classification.

10. The philosophical views of Mr. MacLeay regarding the circularity of groups, left it almost certain that the law which applied to other classes might be also applied to fishes; and as the essence of that law consists in the tendency of the contents of natural groups to form a circle, it became highly probable that as strictly herbivorous Carps were known, so on the contrary carnivorous species might be expected also to exist.\* This is exemplified by a comparison of typical with subtypical groups, as *Quadrumanæ* with *Feræ* in the orders of *Mammalia*, and *Insectores* with *Raptores* in the orders of birds; as this is true with regard to higher groups, it should be just as applicable to the lower assemblages when they happen to be equally complete in their parts.

11. The above inference whether its principles be just or not, has proved to be perfectly correct, notwithstanding the remark of Linnæus that Cyprins are perhaps the least carnivorous of the whole class of fishes, "feeding chiefly on seeds, grass, and even mud;" and the observation of Cuvier "that they are the least carnivorous of all fishes." Those who have since written on the subject have for the most part adopted the views on this point of the great authorities just named.

12. A close investigation of our Indian species has led to very different results, and enabled me to form *Cyprinidæ* into three sub-families. First the *Pæonominæ* or herbivorous Cyprins already adverted to, which

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\* I here refer particularly to what Mr. MacLeay calls affinity of transultation, or that relation which the opposite points of a circle of affinities bear to each other.

consist of species whose habits accord with the views of Cuvier and Linnæus; and *Sarcoborinæ* or carnivorous Cyprins, consisting of several natural genera; and *Apalopterinaæ*, including the *Cobitinæ* or Loaches, the *Pæcilianæ*, *Cyprinodons*, and other genera which in the Regnè Animal appear to have little connexion with the family, as well as some new forms peculiar to India.

13. As the peculiarities of the first sub-family, consisting in the form of their mouth and digestive organs have been pointed out, I shall now proceed to notice the characteristics in structure and habits of the several groups of *Sarcoborinæ*. Two of the most remarkable genera of this sub-family are the Perilamps and Opsarions; the first, consisting of small insectivorous fishes remarkable for the brilliancy of their colours, always disposed in streaks. The second are lengthy handsome species, larger than the Perilamps, though still of small size and very bright in their colours, which are however disposed in cross bars,—these are exclusively carnivorous, and remarkably voracious.

14. The Perilamps (*Perilampus*) form the connection between the Systems and Leuciscs. The mouth is placed in a directly opposite position from that which it occupies in the typical forms of the *Pænominaæ*; the jaws are directed upward, and their apices are placed on a level with the back or crown; their intestine is short, and in no instance exceeds the length of the body, and their food consists of insects only, which they derive by springing from beneath the surface of the water, thus forming a direct contrast to the Gonorrhynchs and other *Pænominaæ* whose food is exclusively derived from sandy, rocky, or muddy bottoms. Eleven or twelve species of this new genus are described in this paper.

15. The Opsarions (*Opsarius*) differ from herbivorous Cyprins still more widely in their economy and habits. The body is long, the mouth widely cleft and horizontal, and though without teeth, the symphysis of the lower jaw is armed with a sharp hook in the more characteristic, but which is blunter and less prominent the further we pass from the most typical.



forms; but this hook more or less developed, is characteristic not merely of the Opsarions, but of the sub-family (*Sarcoborinæ*) to which they belong. It is received into a corresponding depression in the apex of the upper jaw when the mouth is closed. The back is straight, the dorsal is placed opposite to a long anal, both fins being situated near the caudal extremity, by which the power of darting or springing is rendered most perfect.\* The abdominal cavity is long, and is chiefly occupied by a straight stomach of equal length, which is divided by a strangulation from a short fleshy intestine connecting the stomach directly with the vent, without any convolutions or elongation of the tube.

16. "The energies of nature," to use the words of Mr. Swainson, "are here concentrated as it were to the production of that form most adapted for one especial purpose," that of springing on their prey like the *Felinæ* or cats, which they seem to represent. It is no uncommon thing to find an Opsarion so overgorged that the tail of its prey remains protruding from the mouth, to be swallowed after that portion which is capable of being received into the capacious stomach is sufficiently digested to admit of the introduction of the remainder. †

17. Two other genera of this sub-family remain to be noticed; viz. *Systomus* and *Leuciscus*. The first is made up chiefly of small species named Pungti by the Indian fishermen. If we were merely guided by their general

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The principal instrument of progressive motion in fishes is the caudal fin; other fins, as shewn by Roget, are mere auxiliaries, serving to balance the body while it receives propulsion from the tail. Vide Bridgewater Treat. i. 286. This is correct in regard to fishes in general, but in the Opsarions and Perilamps the dorsal and anal, from their position and size, contribute greatly to their velocity, being also situated on or near the tail, thus increasing the caudal surface, which, as Roget justly observes, operates as an oar does in sculling.

† I have seen Opsarions so often in this state, that I presume they are easier caught in it than in any other. A similar power of deglutition is recorded of sea-gulls by Blumenbach.

appearance and the form of their fins, the only principle of division hitherto adopted in this family, they might be brought into the several sub-genera *Cyprinus proprius*, *Cirrhinus*, etc. of the Regnè Animal. Buchanan, who published his Gangetic Fishes contemporaneously with Cuvier's system had not an opportunity of consulting its divisions, while those of Lacepede, Bloch, and previous writers were not reconcilable to Indian species; Buchanan therefore formed temporary groups for his own convenience, applicable to the local features of the family in this country. The Pungti, like all his other groups, were formed according to native opinions of their habits unshackled by artificial views, and being better marked than most genera, Buchanan's Pungti have more or less affinity to each other.

18. The stomach and intestine of the Systems are in none of the species I have examined more than thrice the length of the body, and the former which is thick and fleshy, usually contains the remains of insects. The mouth is small, and when opened, the intermaxillaries project so as to form a narrow tube,—hence their generic name.

It is in the Systems we first perceive a tendency to the hook or prominence on the apex of the lower jaw after quitting the herbivorous genera, and for this reason, as well other peculiarities which appear to point them out as a typical or most perfect group, they are placed first in the list of carnivorous genera.

19. The Leuciscs or white fishes, succeed the Perilamps. In this genus the prominence on the lower jaw is more distinct, and I have restricted the genus to such as possess this character, having at the same time the dorsal and anal small, the former placed anterior to the latter. They are all carnivorous, but not constructed for leaping above the surface like the Perilamps, nor for springing like the Opsarions; although the shortness of the intestines, size of the stomach, and prominence of the tooth on the

lower jaw prove them to be scarcely less rapacious; yet I am not sure as to the accuracy of separating them from one or other of the preceding genera, merely on account of the size and position of the dorsal and anal fins, particularly as the dental hook is only of importance in distinguishing them from some of the *Pæonominæ*.

20. After this outline of the structure of *Sarcoborinæ*, a few remarks regarding their colours will be necessary, as embracing another principle on which the divisions have been formed. The whole of the sub-family *Pæonominæ* are remarkable for their uniformly plain colours, consisting of olive-green, bluish-grey, or brown extended along the back, and softened off on the sides so as to leave the lower surface of the body an impure white, partaking more or less of the colours of the back. The fins partake of the sober hues of the adjoining parts of the body, the pectorals and ventrals, as well as the branchial membranes and irides usually displaying after death a slight blush of red caused by the capillary effusion of blood in those parts. Of the species with which I am acquainted, not one possesses a brilliant spot of any pure colour, but when we approach the limits of the next group we begin to find in the Gonorhynchs, obscure dark spots on either side of the tail of some of the species, as *G. bimaculatus*.

21. But, on the other hand, as soon as we cross the verge of the herbivorous group and enter the carnivorous, we find such spots as those alluded to become brighter and more numerous, and the opercula and fins to be stained with yellow and red in deep and natural tints. To *Systomus*, the first genus of this group, the Gold-fishes,\* commonly called Golden Carp belong. The intestinal tube of the Systoms though only thrice the length of the body, or half the length of the abdominal tube in those herbivorous species in which it is shortest, is nevertheless twice the length of the same organ in any of the

other *Sarcoborinæ*. As we advance in this sub-family from the Systems towards the Opsarions, we find as has been shewn, the abdominal tube diminishing in length, and in proportion as this takes place, and the habits of species become more carnivorous, we observe the brilliancy of the colours becomes more remarkable.

22. The Perilamps, as already stated, are followed by the Leuciscs. In these the diversity of colour is not great, but is compensated for by the metallic brilliancy of the nacre, or silvery pigment with which the scales and opercula are covered, and from which the genus has derived its name *Leuciscus*, *Ables*, or white fishes, though not applicable to all the species; for there is one which is marked on each side with the bright longitudinal streak of the Perilamps, and like the blending of the markings already observed between the *Pæonominæ* and *Sarcoborinæ* the species in question, *Leuciscus lateralis*,\* seems to unite the white fishes with the Perilamps.

23. The Perilamps in their structure naturally follow the Systems, and present numerous bright longitudinal lines of various colours, but particularly blue on their sides. They are all small species of little or no direct utility to man, nor is it possible to account for the peculiar brilliancy of their colours in any other way than as an instance of that inscrutable design, by which it would seem that in pursuit of aquatic insects on which they subsist along the surface of waters, they become the better marks for Kingfishers, Skimmers, Tern, and other birds which are destined to keep the number of fishes in check, especially in deep waters beyond the reach of the waders.†

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\* *Cyp. Daniconius*. Buch. which appears to me to be identical with *Cyp. Anjano*, id.; but if not, the latter species on account of certain peculiarities about the mouth, which seem to be wanting in the former, must be referred to the Perilamps.

† See remarks on *P. perseus* in a subsequent part of this paper.

24. The Opsarions are *Cyprinidæ* that live upon other species of their own class ; they are no less remarkable for the peculiarity of their colours than for their remarkable structure and habits. Instead of the longitudinal stripes of the Perilamps, they are characterised by transverse bands or spots, having a tendency to form cross bars on the sides. The analogy between the structure and character of the Opsarions and *Felinæ* has already been referred to (16). Why the former should present similar external markings to those which belong to the most destructive types of quadrupeds and birds cannot well be accounted for on other principles than those of symbolical representation, by which an uniformity of design appears to extend throughout all the infinite forms in the animal kingdom. As an ignorant confidence in this or any other doctrine would be as absurd as a denial of any thing else with which we are imperfectly acquainted, the only way in which we can evince our respect for those who have opened so vast a field for inquiry is, to imitate their industry, leaving our views to be slowly formed and matured with the progress of inquiry—the only way in which sound or useful results ever were, or can be, elicited in scientific pursuits.

Green appears to be the characteristic colour of the markings on the sides of Opsarions, as blue or purple forms those of the Perilamps ; and those Opsarions that are not either marked with transverse green bars, or oblong spots of the same colour transversely placed with regard to the body, are covered with a silvery pigment similar to that of the Leucises.

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Nothing is more easy, or more common because it is easy, than to announce as discoveries the startling results of immature inquiry into obscure subjects ; yet when we consider the comparatively small amount of real discovery solely attributable to Newton, compared with the extent of his application, and how seldom a Newton appears, we should always receive with suspicion the supposed discoveries of persons who from their frequent appearance in public, and the number of their occupations, argue a sad deficiency in all those qualities essential to the promotion of any science.

25. In consequence of the important connection between colour and structure here pointed out, I am in some doubt as to the nature of four small species described by Buchanan,\* and figured in the collection of his drawings at the Botanic Garden. Two of them have been figured in the Gangetic Fishes, and one a second time in Hardwicke's Illustrations; but in the published figures, the peculiarity of the colours to which I allude, and which seems to have been preserved in the original drawings has been overlooked. They have the form of Cirrhins, but they are each marked with a dark spot at the end of the tail, and the colours of the back descend partially across the sides in bars as low as the situation of the lateral line. I have added the species in question to the Cirrhins as *Cirrhinoids*, until we know something more of them. Should they prove from the length of the abdominal canal to belong to *Sarcoborinæ* as their colours indicate, they will occupy a place between the Opsarions and the Loaches.

26. The third sub-family *Apalopterinae*, consists of the old Linnæan genus *Cobitis*, the *Anableps*, *Pæcilia*, *Lebias*, *Fundulus*, *Molinesia*, and *Cypri-nodons*, as well as two other genera, *Platyccara*† and *Psilorhynchus*, to be described in a subsequent part of this paper. These fishes are all remarkable for their long cylindric bodies covered with a slimy mucous, the absence of spines in any of the fins, and the shortness of their alimentary canal.

Mr. Gray has recently separated the Loaches with suborbital spines from those that are without these singular organs. I have endeavoured to find farther reasons to strengthen this division, a single character being insufficient

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\* *Cyp. Dero.* Buch. Gang. Fis. Pl. xxii. f. 78. *Cyp. Morala*, id. Pl. xviii. f. 91. *Cyp. joalius* id. *op. Cit.* 316. *Cyp. Pausius*. id. loc cit.

† Named by Mr. Gray as Buchanan's *Balitora*, which rather correspond with my *Psilorhynchus*, *Psil. variegatus* being Buchanan's *Cyprinus Balitora*.

to distinguish a natural group without some more general reference to habits and structure. Not having been successful, I am obliged to resort to another arrangement which appears to be more natural, and at the same time equally obvious; the caudal of the one sub-genus (*Cobitis propria*) being entire, and that of the other (*Schistura*) bifid, or divided into two lobes as in the ordinary Cyprins. Colour is here a no less important guide than we have found it to be in *Sarcoborinæ*. Green disposed in bars and zones crossing the body characterises all the *Schisturæ* except a single species (*Botia grandis*, Gray) in which the colour is green, with oblong light yellow spots, or rather short interrupted streaks, irregularly disposed in all directions.

The true Loaches (*Cobitis prop.*) on the contrary are all brown, inclining in different species to red or yellow, disposed in nebulous blotches or obscure bars having a transverse tendency.

27. The structure of the digestive organs in the Loaches and *Schisturæ* does not appear to be very different, but in the latter the intestine seems to be somewhat longer than in the former, exceeding in the one genus the length of the body, while in the other it falls short of this. In both, the stomach is a small lunate sack placed cross-wise with regard to the body, with both orifices in the front, thus differing in this peculiarity from all other *Cyprinidæ* that I have examined. The mouth is small, and placed in the lower surface of the head, and surrounded by minute cirri. Besides the difference in the caudal fins, length of intestine, and colour in the two sub-genera of *Cobitinæ*, the body in *Schistura* is often arched above and below, and compressed the same as in *Cirrhinus* and the generality of Cyprins, but in *Cobitis propria* or true Loaches, it is almost cylindrical, and generally very long. Some of the *Schisturæ* are possessed of an air vessel placed as usual in the upper part of the abdomen, of an oval shape, and divided into two lateral cells by a

longitudinal septum; but in *Cobitis prop.* or Loaches with entire caudal, I have not found any trace of that organ in the ordinary position, but in different species that I have dissected, it is placed in a small bony case over the entrance to the œsophagus; this case consists of a single sub-globular cell, although in the European species it has been found to be bilobate. In those *Schisturæ*, on the other hand, which are without the abdominal natatory bladder, I find the organ situated over the entrance to the œsophagus as in *Cobitis prop.*, but formed of two small globular cells, joined together by an intermediate tube.

28. Having thus explained the general principles on which I have sub-divided the family, it may be useful to examine how far the results are likely to correspond with those laws that have been laid down as the basis of natural classification. With this view, we should first of all endeavour to ascertain the denomination of the family, or its relation in point of rank to fishes in general; but as this could only be done after analysis of the whole class, we can only attempt to form an estimate on the subject by comparing *Cyprinidæ* with what seem to be analogous groups in other classes, to which the philosophical views of Mr. Macleay, Mr. Swainson, Mr. Vigors, and other writers on the natural system have been extended.

29. It might be unnecessary in a communication of this kind, to offer any remarks on the general principles of the natural method of arrangement, as these are fully expounded in popular introductions that ought to be universally read, as well as in several papers that have been published within these last twenty years in the transactions of the Linnæan and other learned Societies. I may however remark, that in addition to those affinities by which animals are immediately connected, there are more remote relations called relations of analogy, by which they typify or represent each other, “a principle which,” as Swainson observes, “was in some degree perceived by



Linnæus when he compared ruminating quadrupeds to gallinaceous birds,\* both of which evince the greatest intelligence, docility, and contentment under the domestication of man." Appendages to the head, whether in the shape of horns, crests, or fleshy protuberances, and the property of affording wholesome and nutritious food, and otherwise contributing to the ease and support of man, are according to Swainson the chief attributes of the type to which the above analogy refers.

30. The Elephant, horned cattle, domestic poultry, etc. are common instances of the type alluded to, and if we compare their properties in their respective circles, with the *Cyprinidæ* in the order of abdominal malacopterygians, we may venture perhaps to look upon that family as the equivalent in its circle, to other rasorial groups in theirs.

31. The mouth of *Cyp. Calbasus*, Buch. is small, and directed downwards, the anterior lip is compressed by a pendulous muscular snout to which four short muscular cirri, different from the nervous filaments of *Siluridæ* are attached,† and the posterior lip is fixed to the ligamentous union of the transverse apophyses of the lower jaw. In the *Cirrhus* the lower jaw is composed of two short branches or bony limbs, obliquely inclined towards each other from their articulation to the blunt apex of the jaw, where they are united by ligaments instead of symphysis at the approxi-

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\* Such analogies were, as Mr. Macleay has shewn, known to Aristotle, by whom however, as well as all subsequent writers up to the time of Mr. Macleay himself, they were mistaken for affinities.

† The cirri of *Cyprinidæ* are soft and capable of being contracted and elongated, as well as the loose muscular appendages of the snout to which they are attached, particularly in the genus *Cirrhinus* Cuv. ; but in *Pimelodus aor*, Buch. and most of the *Siluridæ* I find the cirri are flat and cartilaginous, with a groove on either edge for the protection of a large nerve, an artery, and a vein. A *cirrus* so constructed is incapable of muscular action, and is strictly an organ of sense only, and not of prehension as in *Cyprinidæ*, and ought to be called a filament.

mation of a slender apophysis from each side. Figs. 4, 5, 20, 21, Plate 54, show the under side of the right ramus of the lower jaw (natural size) of four species, *a*, being the point of approximation with its fellow at the chin, and *b*, the articulating extremity behind.

32. This structure is evidently adapted to the habit of collecting fruits, seeds, and other soft substances from the muddy and sandy bottoms of indolent streams, in which loose detached objects of the kind are most likely to occur, and where they may be easily collected without bodily effort by means of these soft pendulous and prehensile organs attached to the lips. If to these characters we add the great size of the species compared with the rest of the family, and the plain dusky colour of the Cirrhins, their analogy to the proboscidian types of quadrupeds seems almost complete. But there are still other remarkable points of resemblance between the Cirrhins and rasorial forms among the quadrupeds, in the deficiency of teeth, and the weakness of the union of the two limbs of the lower jaw.

33. In the Elephant this jaw is only formed for grinding such substances as are introduced to the mouth by the proboscis; there are no cutting teeth, the use of which in gathering food being superseded by the trunk. In all animals possessed of such an organ, prehensile and cutting teeth appear to be less prominent according to the degree of its development; of this we have instances in the Tapirs and Edentates. In the *Sarcoborinæ* the incisors and prehensile teeth are represented by a formidable knob on the symphysis of the lower jaw, and in the *Pæonominæ*, where even this symbol is wanting, we find such of the genera as are without strong muscular appendages to the snout, furnished with a cartilaginous rim to the mouth, which in some, as the Gonorhynchs, is confined to the edge of the lower lip, as a covering or defence when employed in detaching their peculiar food from the rocks to which it is fixed, and may for this reason, be considered as the last semblance of a structure equi-

valent to cutting teeth;\* but in the Cirrhins even this is quite deficient. Nor does the analogy between these fishes and proboscidian quadrupeds end here; the presence of cutting teeth implies a strong solid union of the two bony limbs of the lower jaw at the symphysis for their insertion, but in the *Edentates* and Elephants the symphysis is remarkably feeble; the two sides of the jaw being nearly separated by a deep fissure almost detaching its limbs from each other, as actually occurs in the Cirrhins, with which I include Labeos, which are also furnished with similar prehensile organs in the form of thick pendulous lips. So many corresponding circumstances between animals so remote from each other in the scale of affinity, cannot be referred merely to coincidence, but rather to a law of symbolical representation, by which the same type appears throughout an infinity of forms in the several classes.

34. If *Cyprinidæ* be a rasorial group, as the above analogies of their most perfect forms with rasorial quadrupeds would seem to indicate, the same relations should appear on contrasting them with other classes, the corresponding points becoming more striking or faint in proportion as the groups with which they are compared are contiguous or remote from them; therefore, as birds are nearer to fishes than quadrupeds, the comparison of analogous types between these classes should afford more striking results than those I have cited.

The most remarkable characteristic of rasorial birds is their shortness of wing, terrestrial habits, and consequent strength and size of their legs, which are formed for the principal support of the body, and in some almost

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\* Mr. Evans pointed out to me a peculiarity, for which he could see no object, in our skeleton of an Indian Rhinoceros, consisting of two minute incisors scarcely larger than those of a Rabbit, and hardly projecting from the alveolar; yet these teeth, so small as to be utterly unfit for any useful purpose, are found in every individual of the species. We can only regard these, and all such organs of which the animal kingdom presents innumerable examples, as the characters by which nature distinguishes her various types.

supersede the use of wings. It may be thought difficult to find among fishes a terrestrial type; but as water is the natural element of this class, so the ocean is its metropolis; and those kinds that are confined to rivers and the interior of continents may be safely looked upon as more terrestrial than the rest, and consequently so far equivalent in their habits to rasorial birds; and, while there is no instance of rasorial birds possessed of aquatic habits, or, as Swainson observes, "frequenting water or even its vicinity,"\* so no species of *Cyprinidæ* is known to belong to the sea. In India the *Cyprinidæ* are exclusively confined to fresh water, mostly keeping beyond the influence of the tides, thus evincing a propensity for land analogous to that of Rasores.

35. There is perhaps no point better settled in comparative anatomy, than that the pectorals of fishes represent the upper extremities of the higher classes of animals; short pectorals may therefore be said to be equivalent to short wings in birds; but it is a question of much interest to determine fully how this applies to the case before us, and if it is to be relied upon as a true analogy.

In the Frog and several reptiles the scapula has been found by Cuvier and Geoffrey to be composed of two osseous pieces, agreeing with the two upper bones of the posterior frame or jamb of the branchial aperture in fishes, and a third or lower bone assists in forming a girdle to which the pectoral fins are fixed in *Siluridæ* and most fishes of the same order, with the exception of the *Cyprinidæ*, and particularly the herbivorous section of the family (*Pæonominæ*). These bones were found by the most satisfactory analysis to represent the humerus, or bone which gives support to the third row of quill feathers in birds. Below this bone there is a stylet, which in Cyprins is *merely rudimental*. It was found by Cuvier to represent

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\* Geog. Dist. and Class. of Animals, p. 259.

the ulna and radius, or, in other words, to be equivalent to the cubitus or bone which sustains the secondary quills in the wings of birds.

36. Thus, two bones which in birds constitute the larger portion of the wing, may be said to be almost deficient in herbivorous Cyprins, though they are more developed in many species of the carnivorous section of the family, and still more complete and uniform in other families of the same order, as *Siluridæ*.

37. It is hardly necessary to enter into farther analysis to prove that the pectorals of *Cyprinidæ* in general, but particularly of herbivorous Cyprins, are less complete than those of neighbouring groups; for we are at once struck with the fact, on observing the small size of the pectoral fins in all our *Pæonominæ*, and the slenderness of the rays of which they are composed; while the large clumsy rays of the ventrals, and the strength of these fins, are circumstances that cannot be overlooked, and which, when viewed in comparison with the strong and fully developed legs of Rasores (34) supply all that is essential in the analogies between the groups in question.

38. In the most carnivorous species of *Sarcoborinæ* on the other hand, and especially in some of the Opsarions, as *O. polioæus*, and *O. pholicephalus*,\* remarkable instances are observed of excessive development in the pectoral fins, and this is always as far as I have seen, attended with a proportionate want of size in the ventrals, which are so slender and small in this genus, and their structure so delicate, as to render it hardly possible to conceive that they can be of much use in aiding the movements of the body. Now the widely cleft mouth or beak, great breadth of wings or pectorals, obsolete ventrals or feet, are common to Opsarions and Fissirostres, so that the first would thus

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\* t. 47, f. 2, 3.

appear to be a natatorial type of *Sarcoborinæ*, corresponding with that type in the order of perching birds. To this however there is some objection, for if the *Sarcoborinæ* represent the *Feræ*, the most carnivorous genus of the subfamily (which Opsarions would seem to be) ought to represent the *Falconidæ* in which there is only one genus (*Gypaëtus*) remarkable for short feet and great breadth of wing; but the cruel habits and voracious appetite of the Opsarions go to establish this last as the true analogy; this however as well as many other points must remain to be decided by further inquiry. In the mean time we may be justified in the conclusion that the *Feræ* among the *Mammalia*, and the *Falconidæ* among birds have their representatives among the *Cyprinidæ*, and that the same type in each of the three groups seems to possess certain corresponding characteristics which may distinguish them from all adjoining groups, and that in describing those characters, the same terms are as applicable to the one as to the other, which is quite sufficient to prove their corresponding analogies.

39. It may be objected to by those who have not paid much attention to the subject, that detached comparisons of this nature are of little value; still, they are important as the means of directing attention to characters that would otherwise be liable to be passed over unobserved, I am therefore disposed to pay little regard to such objections. The number of species and groups are now so much multiplied in every department of natural history, that detached descriptions are daily diminishing in value; and, besides, it is so easy to make a new genus if not required to shew our reason for doing so, that we need not be surprised that it should now have become a regular trade, and that many acquire a temporary fame with the unthinking part of mankind by the practice.

40. The first test of a natural group is the circularity of its contents. To ascertain whether the affinities of the *Cyprinidæ* are circular, it is

necessary to recollect that the herbivorous Cyprins are characterised by their plain colours and great length of intestinal canal, which varies from six to twelve lengths of the body in the different groups; those with the shortest (the Barbels) intestine being in the centre of the sub-family, it follows that the two extremes must meet, or shew a tendency to approximate or close. The herbivorous Carps are united to the *Sarcoborinæ* by means of the Gonorhynchs and Systoms, and shew like the last a tendency to form a circle of themselves, though it is probable that the group is yet far from being complete. The *Sarcoborinæ* and the Loaches are united by two new types, the *Platyca* and *Psilorhynchus*; and the *Schistura* in addition to approximating to the *Platyca* unites, or shews a tendency to unite both in form and habits with the *Pæonominæ*, the group with which we set out; thus exemplifying the first principle of natural classification, namely, that every natural series of beings in its progress from a given point, either actually returns, or evinces a tendency to return again to that point, thereby forming a circle.\*

41. The second test of a natural group relates to the number of its types. On this point there exists some difference of opinion among writers on the natural system, which their profound inquiries are now doing much to remove. It is a question which, to understand sufficiently for practical purposes, requires an extensive knowledge of natural history, and a mind somewhat more imbued with the spirit of philosophy than has hitherto been considered requisite in those who ventured to name new genera. It has already been said that the lower jaw of the Labeos agrees with that of the Cirrhins, in being formed of two bones articulated behind to the anterior process of the preoperculum, and that in front a transverse

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\* Swain. Nat. Class. and Geog. Dist. Anim. 224.

apophysis is given off on either side, so as to meet nearly in the middle, where they are united by ligaments and muscles at the chin, which is square, with a fissure in the middle.

The lower jaw of the Barbels is composed of two longer limbs (Fig 6, Plate 54) articulated behind as in the Cirrhins, but without transverse apophyses in front, where the two bones are united by symphysis, or close union firmly cemented as it were with cartilage.

In the Gudgeons the chin is rounded horizontally without the depression in the middle observed in that of the Cirrhins, or the acute lengthened apex of the Barbels, and is composed of a solid bony rim formed of a transverse process directed from each corner of the mouth to the centre, where it is firmly united to its fellow by symphysis at the chin; at the corners of the mouth these transverse processes turn backwards at right angles (as in *Cyp. bata*, Buch. Fig 3, Plate 54) and sometimes at still greater angles as in (Fig 2, Plate 54) *Cyp. mrigala*, Buch. This last process is articulated behind to the anterior process of the preoperculum, and corresponds with Cuvier's angular bone in the Perch.

42. The angular transverse processes in this last form have every appearance of being two distinct pieces (*c.* and *d.* Fig. 2, Plate 54) consolidated in adults by a bony union at the corner of the mouth, yet formed from distinct centres of osseous deposit. Now as these three forms are each attended with peculiar traits of character in regard to the nature of food and the manner of obtaining it, as well as in the structure of their digestive organs, we may be sufficiently justified in regarding them as characterizing three types which, if we like, we may term primary. This view is farther supported by the fact that, to one or other of the three forms in question, variously modified, the lower jaw of all the Cyprins of this country may



be referred. In *Cyprinus semiplotus* (Fig. 1, Plate 54) the angular process is merged into the transverse, the first being only distinguished by the pterygoid process (*c.* Fig. 1, Plate 54), which we know from all the other species examined to belong to the angular limb (*d.* Fig. 2, Plate 54) and not to the transverse process on which it is in this species placed, while the analogy to the type of the Gudgeons is preserved by an additional transverse bone being placed parallel to, and in front of the first (*e. e.* Figs. 1 and 2, Plate 54.) Of the positive value of these characters, I may mention that *Cyprinus mrigala*, Buch. is indicated by Cuvier as a *Cirrhinus*, but proved by this method of analysis to belong to the Gudgeons (*Gobio prop. J. M.*) having as well as the peculiar affinity here pointed out, the lengthened alimentary canal of that genus. *Cyprinus prop. Cuvier*, I suspect will be found according to these principles to agree in its natural affinities either with the Barbels or Cirrhins, as the length of the dorsal and the presence or absence of a spinous ray are scarcely sufficient distinctions even for a sub-genus; and the Catastomi and Labeos of America will, I presume, be found to arrange themselves naturally with the Cirrhins.

The lower jaw of the Gonorrhynchs is composed of two limbs placed nearly parallel to each other, and as in the Cirrhins not united in front, but with this peculiarity—that the os hyoides is prolonged to the chin, at which situation the anterior extremities of the three bones are tied together with ligaments.\*

In the Opsarions, and generally throughout the *Sarcoborinæ*, the second form of jaw prevails, with the addition of being more acute at the symphysis; this form also seems to prevail in the *Cobitinæ*, but in these the

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\* Vide Jour. As. Soc. Beng. 1835. p. 40, where I described this structure in *Gonorrhynchus petrophilus*.

bones of the jaw are soft and flexible. The limbs of this organ are round and slender in *Cobitis prop.*, but firmly united in front by means of two expanded apophyses, while in *Schistura* they are flat and obliquely inclined to each other, so as to form by means of their inner edges a lengthened symphysis.

43. Thus we appear to have three primary types; the first distinguishes the Cirrhins, Labeos, and probably Catastoms; a second is peculiar to the Barbels, Opsarions, and numerous other genera; and a third is seen in the Gudgeons. From these three types being so prominently developed in the *Pæonominæ*, while one principle chiefly seems to run through all the *Sarcoborinæ*, it is perfectly legitimate to conclude even from this circumstance alone, that the former should be the most perfect group of the two, and that its species should consequently be endowed with more diversified instincts; hence, although a vegetable regimen is the great characteristic of the *Pæonominæ*, still many of the species are omnivorous, and this is to be expected, especially among the Cirrhins and the true Carps (*Cyprinus prop.* Cuv). The Barbels, however, as well perhaps as the Breems which appear to be peculiar to Europe, seem to partake more of carnivorous habits, and therefore must be held as the sub-typical, while the Cirrhins are the typical\*, and the Gudgeons and Gonorhynchs from their possessing in the greatest perfection the single instinct for a tendency to which the *Pæonominæ* are most remarkable, viz. subsisting exclusively on a vegetable regimen, are as unquestionably the aberrant forms of *Pæonominæ*; on the other hand the rapacious habits of the *Sarcoborinæ* mark them so conspicuously as a sub-typical group, corresponding as they do with the habit of that group in devouring other animals, that it is unnecessary in this place to offer a remark in support of a fact so plain.

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\* The Cirrhins being the most perfect forms of a typical group, are strictly, in the language of Mr. Swainson, *pre-eminently* typical.

44. The consideration of the third or aberrant group in *Cyprinidæ* involves some points which will not be so clear to those who have not studied the principles of natural classification. This group should possess three types, and these should be so related as to form a circle of affinities among themselves. This property has suggested the following proposition to Mr. Swainson, which tends to reconcile some diversity of opinion that formerly prevailed as to the number of primary types—"The primary circular divisions of every group are three actually, or five apparently." The three aberrant types are named by Mr. Vigors (Lin. Transac. vol. 14) from the corresponding groups in ornithology, natatorial, suctorial, and rasorial.\* The third type I find to be represented by the Loaches, but before we enter into a consideration of that part of the subject, it is necessary to point out the two first types which I have already only alluded to; this I must do by entering into more particulars than may seem to be necessary.

45. Buchanan in defining his ninth division of the old genus *Cyprinus* which is composed of Gonorhynchs, as I have already pointed out, gave them the barbarous name of *Garra*, and compares their habits to those of the Loaches, and observes that they are called *Balitora*, or sand-diggers, by the natives; a name I may observe which in Assam, and I presume also in Bengal, is applied to Loaches only. Indeed the Gonorhynchs, or *Garra* of Buchanan are peculiar to mountains, from whence they are driven down during floods, and do not extend beyond the rapids that skirt their base, so that they can scarcely be said to be entitled to any Bengal name. In this group Mr. Gray detected a new genus, to which I wish he had given a more appropriate name than *Balitora*; for independently of the

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\* As these terms have been applied conditionally by Mr. Swainson to *Mammalia*, I need make no apology for following the example of so good an authority in applying them to fishes. Indeed I have been guided entirely by the views of Mr. Macleay, as exhibited in the Linnæan Transactions, and the works of Mr. Swainson from beginning to end of this paper.

species being different from any of those described by Buchanan, and supposed by him to be the *Balitora* of the natives, Mr. Gray's genus is peculiar to mountain torrents, the beds of which are usually rocky rather than sandy; for this reason as well as from the fact of the *Balitora* of Gray forming a new type distinguished by a flat head and other remarkable characters, I propose for it the generic name *Platycara*.\* Several specimens of this genus, corresponding I suspect with the spotted species of Gray, *P. maculata*, Plate 49, fig 2,† were brought down from Bouton by Mr. Griffith, but they were unfortunately in such a decayed state when opened, that we have been unable to obtain from them a very full specific description. I have however from these specimens been able to satisfy myself on other points connected with their structure, and find not merely that they are distinct from the Gonorrhynchs (*Garra*, Buch.) in consequence of their short fleshy abdominal tube which does not, including the stomach, exceed the length of the body, while that of the Gonorrhynchs is equal to eight lengths of the body, but that their broad and blunt head is more like that of a *Silurus* than a *Cyprinus*. Their character is rendered still more remarkable by the great breadth and position of the pectorals situated almost beneath the eyes, and the fleshy pedicles or arms on which they are placed, are decided analogies to natatorial forms. If we compare the characters of the *Platycara* with

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\* From *platus* broad and *kara* the head.

† From the importance here given to these species as forming a new type, I have transferred the two figures from Hardwicke's Illustrations in which there is no description of them, to Plate 49.

Since the above was written the collectors employed by my friend Mr. Griffith in the Kasyah mountains have obtained an additional species, and as their liberal employer has no object to serve beyond the interest of science, he has freely permitted me to make use of this or any similar object of zoological interest contained in his collections. The species alluded to, *P. nasuta*, is described in Prinsep's Journal of the Asiatic Society for November, 1838. Pl. 55, f. 2. See also Pl. 57, f. 2, of this paper; in this species the pectoral pedicles are very slightly developed.

those of the natatorial types in the other classes, we are struck with the analogy—"a blunt truncated muzzle, an obtuse head with strong jaws for seizing animal food." The short intestines of the *Platycara* prove their habits to be carnivorous, and though the mouth is not very large the jaws are remarkably strong, composed as in the Gudgeons of two limbs soldered in the middle, but much stronger than in the instance referred to. Among birds, the Owls—the natatorial group of Raptores, and the Fissirostres in the circle of perchers, as well as most of the Natatores are distinguished above other birds for their breadth of wing, and the blunt or flattened form of the rostrum or the head, as has been proved by the philosophical analyses of the class by Vigors and Swainson.\*

46. For the next, or suctorial form (Plate 50, f. 1, 2,) we are indebted to two drawings in Buchanan's collection, which are marked "*Stolephorus*," but the Stolephore (*Engraulis* Cuv.) or Anchovies, belong to the *Chupeidæ*, a family remarkable for its narrow or compressed forms. The two figures referred to are not compressed nor sharp beneath, so that they could not belong to the genus Buchanan had in view when he named them on the drawings, and this mistake he seems afterwards to have corrected, as the same two species appear unquestionably to be those described in the Gangetic Fishes, pp. 347-8, under the names of *Cyprinus Sucatio* and *Cyp. Balitora*.†

The muzzle of these species is remarkably flattened and thin, but there is nothing remarkable about the pectoral fins, and the eyes instead of

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\* The *Pæcilianæ* Schn. to which I have added a sub-genus *Aplochelus*, as well as the adjoining genera with flat heads and teeth, I also refer to the same type. Plate 42, figs. 2 3. Plate, 55, f. 4.

† It was probably Buchanan's descriptions of these species Mr. Gray had in view when he bestowed the name *Balitora* on the genus which I now call *Platycara*.

being placed on the upper surface of the head as in *Platycara*, are situated on its edges; the mouth is remarkably small, placed far behind the long and thin muzzle, without any appearance of cirri as in the Loaches, to which Buchanan supposed them to bear a resemblance. This genus which appears to be the suctorial type, I propose to name *Psilorhynchus*.\* The peculiarities just noticed, as well as the position of the eyes which are far back in the head as we see in the Moles, Ant-eaters, and other analogous types among quadrupeds, together with their well formed and fully developed fins, indicative of powers of rapid motion, such as distinguishes the Humming-birds, Cinnyris, Waders, and other suctorial types in the same class. Unfortunately we are not acquainted with the habits of the two interesting species under consideration, farther than that they were obtained by Buchanan in the northern parts of Bengal, to which they have been probably swept from the mountains. The information to be derived from their intestines is however of the less importance as affecting their type, as they would be equally suctorial whether they derived their food from the juices of plants or from shell-fish or ova.

47. It remains to notice the analogical relations of the Loaches, an exceedingly numerous group in India, many species of which are common in every pond throughout Bengal and Assam. In these fishes we shall find the characters of rasorial birds as well as quadrupeds so strongly depicted as to leave no doubt of their forming an equivalent type among *Cyprinidæ*.

When noticing the difference between the true Loaches (*Cobitis*) and *Schisturæ*, I omitted to mention that in the dissections of five species of the former—all I have had an opportunity of examining, I could find no natatory

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\* From *psilo* thin or attenuated, and *rynchus* a snout or beak.

bladder, while in the only species of the latter which I have been able to inspect I found that organ, though small and peculiar in its form, yet sufficiently developed to lessen considerably the specific gravity, enabling the *Schisturæ* to swim with facility, though perhaps with less buoyancy and ease than other *Cyprinidæ*.\* But if a natatory bladder exists at all in the true Loaches (*Cobitis prop.*) or those whose caudal is entire, it must be in the manner described by Schneider—very small and enclosed in a bony bilobate case which adheres to the third and fourth vertebræ, but even in this rudimental shape I have been unable to find an air vessel in any Indian species yet examined.†

This peculiarity, together with their small and weak fins, as well as lengthened and cylindric form, approaching to that of the *Muraenidæ*, afford satisfactory evidence that they are less adapted for swimming than any other *Cyprinidæ*, and may therefore be said to be more terrestrial in their habits, living chiefly on sandy and muddy bottoms, or in jeels amidst aquatic vegetation.

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\* *Schistura dario* and *geta* have a membranous air vessel placed in the upper part of the abdomen as in ordinary Cyprins, but it consists only of a single lobe. *S. dario*, Buch. is the only species of the Linnæan genus which I have found to frequent deep waters in the open channels of the Ganges and Bramaputra.

† Since this was written, I have found the air vessel in all these species situated in a small bony case immediately over the entrance of the œsophagus from the mouth. Plate 56. f. 5, is a magnified representation of the organ (which is not larger than the head of a pin) as it occurs in *Cobitis guntea*, Buch. and other neighbouring species of the same sub-genus. Fig. 4, Plate 56, represents the same organ in several of the smaller *Schisturæ*, in which it is also placed over the entrance of the œsophagus, and in both cases probably answers the purpose of the branchial or pharyngeal teeth in the *Pæonominæ*, especially as the external surface of the bony crust which surrounds the air-vessel is, as represented in the figures, studded with minute spines.

How nicely does all this correspond with the character of rasorial birds and quadrupeds given by Swainson! "Their toes are never united so as to be used for swimming, a peculiarity which confines them to dry land or to climbing among trees." "This is the type," says the philosophical observer just alluded to, "so remarkable for the greatest development of tail, and for those appendages for ornament or defence which decorate the head. If we went through the whole class of birds, and selected those beginning with the Peacock, wherein the tail was most conspicuous either for its size or for the beauty of its colours, we should unknowingly fix upon those birds which analysis has already demonstrated to be rasorial types. The same results would attend a similar selection of quadrupeds and of winged insects; all these collectively would furnish many hundred proofs by which the uniformity of this type is preserved; appendages to the head, whether in the shape of horns, crests, or fleshy protuberances are no less a prevalent character of the group now before us."\*

48. These peculiarities will be found exactly to apply to *Cobitis prop.*, which I shall now prove.

First with regard to tail, the Loaches are the only group of *Cyprinidæ* in which the caudal is not bifid or divided by a fissure into two lobes, reducing its size and power as an organ for propelling the body forward; and on the tails of several, especially *Cobitis pavonacea*, J. M.† we have even the zoned or eye-like spots exactly resembling those of the Peacock, although no instance of the kind is to be found in any other group of *Cyprinidæ*; and in all

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\* Geog. Dist. and Class. Quad. 258.

† Pl. 52. f. 1.



Loaches the caudal is barred and otherwise ornamented, while that of every other species in the same family is perfectly plain.\*

Next as to soft appendages to the head, the Loaches surpass every other group in the same family in the number and uniformity of these appendages; and lastly, the Loaches and *Schisturæ* present the very extraordinary relation to the tribe of ruminants, and especially to the *Cervidæ*, or stags, in having articulated to the orbital process of the frontal bone on either side, a formidable horn which can be raised at pleasure from a suborbital sinus analogous to the suborbital sinus in Antelopes, the use of which in them is conjectural. The horn which is concealed in this sinus in the Loaches, appears to be equivalent to the suborbital chain in the Perch, and to the corresponding plates in the ordinary *Cyprinidæ*; it is somewhat flattened or palmated, as in many of the Deer tribe, ending in a sharp point which is directed forward; on the anterior margin and near the base of the horn a strong antler is given off, this is also very sharp, and turned forward like the point of the horn itself.

49. I have shown that *Cyprinidæ* is a natural group, that it is circular† in its affinities, that for instance in setting out from the Gonorrhynchs we

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\* This as well as all similar analogies afforded by the structure of *Cyprinidæ* were developed in the course of my examination of species before I had ventured to form any general views on the subject, and even before I had studied those of Mr. Macleay, or perused the works of Mr. Swainson, which have taught me the importance of characters which although noted, I felt totally at a loss how to use.

† "They might as well be called oval or square." "Why not linear?" The researches of zoologists during the last twenty years have fortunately left me nothing original to say in reply to this criticism, which perhaps deserves notice as coming from a member of the Committee of Papers, Mr. C—. Speaking of describing natural objects in the order in which they succeed each

pass through a succession of species connected together by direct relations, and after arriving at an opposite point (*Opsarius*) at which the forms, habits, and

other in nature, Cuvier and Valenciennes observe, "he alone could build 'up such a pretension who would attempt to place animated nature on a single line, a project which we have long since renounced as one of the most false that could be entertained in natural history."—*Historie Naturelle des Poissons*.

On the same subject, another authority observes—"The day is now happily gone past when zoologists thought that the infinite variety of animals which inhabit this globe owed their origin to the unsuccessful efforts of nature before she could attain the human structure as her term of perfection."—*Macleay—Lin. Transac.*

"As to the rule of natural progression, is it linear? The idea of a simple scale in nature had long been discussed and finally abandoned."—*Swainson's Discourse on the study of Natural History*.

As all natural objects have three relations of affinity, it is clear the chain that connects them cannot be straight, and not being straight the next simplest form is circular, but there is no objection to the progression of affinities being square or oval, provided they can be proved to be so; it is less the form than the circumstance of the opposite extremes of a natural series meeting, that is insisted on.

Some notion of circular affinities appears to have existed from an early date. Hermann in his *Tabula Affinitatum Animalium*, published in 1783, as Mr. Macleay points out, refers to an earlier writer who, like himself, seems to have had a glimpse of the same truth. *Lin. Transac.* vol. 14, p. 49. M. Lamarck detected the existence of a double series which setting out in opposite directions from a given point met together at another. Unacquainted with the result to which Lamarck had been led, Prof. Fischer in 1808, perceived a tendency in the series of affinities to form a circle; but these obscure intimations were first established by analyses in the *Horræ Entomologicæ* of Mr. Macleay published in 1819. Since then Mr. Vigors submitted a general analysis of the whole class of birds to the Linnæan Society, in all the groups of which he found the affinities to confirm what had been observed by Mr. Macleay during his examination of insects, as well as the views contained in a subsequent publication recorded in the Linnæan Transactions, in which the same principles were applied by Mr. Macleay to the whole animal kingdom. The birds of New Holland were subsequently examined by Messrs.

structure differ totally from those with which we set out, we are led back again through a succession of different forms from those through which we passed at first, to the point from which we started.

It has resulted from Mr. Macleay's views applied to the analyses of the classes of birds, quadrupeds, and insects, that "the contents of such a circular group are symbolically (or analogically) represented by the contents of all other circles in the animal kingdom," but as such analyses have not yet been carried through fishes and reptiles, the conclusion just quoted has been submitted rather as a proposition by the distinguished author of the geography and classification of animals whose next proposition is, "That the primary divi-

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Vigors and Horsfield with the same result (vide Linnæan Transactions, vol. 16) and the whole of these observations have since been confirmed, and their results more fully made out by Mr. Swainson, who also has extended his views to the *Mammalia*. About the same period with the publication of the *Horæ Entomologicæ*, the progression of affinities began to acquire additional interest among botanists. M. Agardh and M. Decondolle both published their views on the subject, the first in his *Botanical Aphorisms*, and the second in the *Memoires du Museum*; when, without knowing what had been done by Mr. Macleay, Mr. Fries announced the same results in the *Fungi*, attained by a different form of analysis. Similar views have since been more extensively applied to plants by Professor Lindley in the last edition of his *Introduction to the Natural System*.

Writers on natural history in the present day may be divided into three classes; first, those who recognise no rules but such as appear to be laws of nature, and taking nature as their guide form their views according to the result of observations which are not confined to external characters, but embrace all that concerns natural objects. The second class consists of naturalists who pursue the easier course of following authorities, but their works consist chiefly of technicalities derived from external characters indiscriminately applied to genera and species; their higher groups are consequently constructed according to rule rather than nature. The third class comprises describers of species, whose books are only remarkable for their size and expense. Nor can I altogether overlook upon this occasion another class of persons, who, though they are not naturalists, and scarcely even allow us to call them writers, yet exercise but too often an influence in Societies detrimental to the objects of such institutions, and the real advancement of science.

sions of every group are characterised by definite peculiarities of form, structure, and economy; which, under diversified modifications are uniform throughout the animal kingdom, and are therefore to be regarded as the *primary types of nature*." I shall now merely copy from the work referred to, one of the tabular views of the parallel relations of well known groups of *Mammalia* and birds, adding in the first column what appears from my analysis of Indian *Cyprinidæ* to be equivalent groups, and thus shew at once how far this family of fishes is calculated to exemplify the great leading principles of analogy discovered by Mr. Macleay.

<i>Fam. of Cyprinidæ.</i>	<i>Analogical Characters.</i>	<i>Orders of the Mammalia.</i>	<i>Orders of Birds.</i>	<i>Tribes of Insessores.</i>
<i>Typical.</i>				
PÆONOMINÆ, ..	{ Pre-eminent in their powers of prehension, and in general organi- zation—claws, spines, or nails not acute. .. }	QUADRUMANÆ, ..	INSESSORES, ..	CONIROSTRES.
<i>Sub-typical.</i>				
SARCOBORINÆ, ..	{ Rapacious, feeding upon live animals— claws, or other organs of torture acute. .. }	FERÆ, ..	RAPTORES, ..	DENTIROSTRES.
<i>Aberrant.</i>				
<i>Natatorial.</i>				
PLATYCARA and PÆCILIANÆ, ...	{ Head or rostrum flat and large, anterior ex- tremities more de- veloped in proportion than the posterior— habits carnivorous. .. }	CETACEA, ..	NATATORES, ..	FISSIROSTRES.
<i>Suctorial.</i>				
PSILORHYNCHUS, ..	{ Sizediminutive, upper jaw, mandible, or snout prolonged, .. run, fly, or swim very fast. }	GLIRES, ..	GRALLATORES, ..	TENUIROSTRES.
<i>Rasorial.</i>				
COBITINÆ, ..	{ Head ornamented either with horns or soft appendages—ha- bits granivorous or herbivorous. .. }	UNGULATA, ..	RASORES, ..	SCANSORES.

50. It would be too much to expect from the materials of one zoological province to demonstrate satisfactorily all the properties of natural groups in the minor divisions of this family. That its typical and sub-typical groups are circular is plain enough, from the diminution in the length of the intestinal canal we experience in passing from the Cirrhins to the Barbels; and again, from the Barbels through the Gonorhynchs to the Gudgeons that canal becomes longer, indicating an union between the latter, and the group from which we set out.

The same thing is observed in passing from the Systoms through the Opsarions, Perilamps, and Leucises; a tendency between the former and latter to unite is indicated, thus forming the sub-typical group (*Sarcoborinæ*) into a circle.

A similar thing may be seen in the aberrant group (*Apalopterinae*) in which the *Schisturæ* form one extremity, and the *PlatyCara* the other; the intermediate space being occupied with the *Pæcilianæ*, *Psilorhynchi*, and true Loaches. The entire caudal of the former points out their relation to *Cobitis prop.*, but until analysis be extended to all known species, European and American, the attempt to reduce the smaller groups to any thing like precision would be difficult and uncertain, from the greater chance there is of the series being less complete than in the higher groups, of which we might always hope to possess at least a specimen of each genus. I shall therefore content myself with having submitted the preceding tabular view of the principal group, referring to the elucidation of genera for further details, in the confident expectation that what has already been demonstrated will induce naturalists to investigate the subject from the materials of other countries as well as of this.

We are far from being prepared to point out the most characteristic types even of our Indian groups of this family. Indeed there may yet

be some unexpected forms unknown to us, the discovery of which would necessarily derange any attempt we could now make to trace in farther detail the parallel relations of the minor groups among themselves. Six species collected in the mountain streams at Simla by Dr. MacLeod, and obligingly submitted to me, have proved to be all undescribed, and one of them affords the type of a new genus *Oreinus*, or mountain Barbels, of which I had before received from Mr. Griffith a species from Boutan (*O. guttatus*); but as there was but one specimen in Mr. Griffith's collections, and that considerably injured, I hesitated to form from it alone the characters of a new group.\* This genus has the form of *Gonorhynchus*; the mouth is situated in like manner under the head, but the alimentary canal is considerably shorter, and the dorsal is preceded by a spine as in the Barbels.

51. I am uncertain as to the habits of the European Breams, not having examined them myself; but from all that I can glean on the subject, they appear to be insectivorous, and in the best figures I can find of them the mouth appears to be directed upward, and the anal fin to be long; these characters may prove to be analogies rather than affinities to the Perilamps, and until the point be decided, the parallel relations of the two groups cannot be made out; the only Indian Bream I am acquainted with (*Cyp. cotis*, Buch.) has the character of the Perilamps both in the form of its mouth and length of its alimentary canal, while on the other hand, the old genus *Leuciscus* is not a natural group, some of the European species, as *Cyprinus Cultratus* being doubtless an *Opsarius*,† while others are certainly her-

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\* *Cyprinus Richardsonii* figured in Hardwicke's Illust. t. 94. f. 2. is an *Oreinus*, and may be appropriately named *O. punctatus*.

† *Leuciscus Cæruleus*, Yarrel and *L. erythrophthalmus*, Cuv. appear to be Perilamps, *L. doubla*, *L. lecanostriensis*, Yarr. and *L. alburnus* are also insectivorous. I have mentioned this in a letter to Mr. Swainson in October last, and I have no doubt the hint will be sufficient to direct the attention of this philosophical naturalist to an examination of the whole of the English species.

bivorous,\* and might perhaps be referred to the Gudgeons; but until all these points be settled, it would be idle to dwell farther on the parallel relations between the typical and sub-typical groups.

52. *Cyprinidæ*, of all fishes of equal importance are those that appear to have occupied least, the attention of naturalists; a circumstance the more curious, as in consequence of their being peculiar to fresh waters they are more universally distributed in the interior of continents, where they ought to be more familiar and useful to man than any other family of the same class.

Regarding their distribution, little has hitherto been made known. It would not appear that there is any one species common to Europe and America; it is not however to be supposed that we are yet prepared to form an accurate comparison between the *Cyprinidæ* of the old and new worlds, since the majority of species in either seems as yet to be but ill defined. Nor is it to be supposed that ichthyology has yet been prosecuted in America to an extent at all likely to make us acquainted with the numerous species that must inhabit the extensive lakes and rivers of that continent. Of African species few only are referred to by Cuvier, while the Nile is known to present some species that are not found in the south of Europe. The Chinese species may yet be said to be almost unknown, with the exception of a few determined by Cuvier from the very doubtful data afforded by paintings; although it is seldom that so favourable an opportunity is afforded for collecting information on any branch of natural history, as that which the British embassies in China possessed, for investigating the peculiarities of the fresh water fishes of that empire, from the length of time they passed in boats on some of the principal rivers. Nor is any thing whatever known, as far as I am aware, of the existence of Cyprins in New Holland or any

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\* *Leucis vulgaris*, *L. idus* and *L. rutilus* are probably herbivorous, and according to the length of their intestine may either be added to one or other of the groups here indicated.

of the Polynesian Islands.\* In India the fishes of several of the great rivers yet remain to be investigated, as those of the Irrawaddi, the Indus, and the Nerbudda. A collection of drawings of the fishes of the Indus, prepared during a scientific mission under Capt. Burnes, has recently been deposited in the museum of the Asiatic Society; and Mr. Griffith, to whom every branch of science is as dear as the one in which he is fast rising to the highest station, is now engaged in making extensive collections of, and observations on, the fishes of the same river. The museums of Paris must already be well stored

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\* This and other blanks in our knowledge of the animals of New Holland are now about to be supplied by Mr. Macleay himself, who, in August last, embarked with the intention of pursuing researches in every department of the natural history of New Holland. On his departure from England, Mr. Macleay intimated his desire to receive at Sydney, where he may remain for three or four years, Insects, Crustacea, and other neglected objects of a similar nature from India in exchange for the productions of New South Wales, which he would be happy to supply: Few who entertain a just pride for the scientific character of our country which Mr. Macleay has been the means of elevating, would require the stipulation proposed to induce them to forward the views of one of our countrymen who has already been the means of exalting zoological pursuits to the highest place among intellectual occupations. Considering the intimate intercourse now established between Calcutta and Sydney, it is to be hoped that an appeal to India, from such a quarter, will not have been made in vain, and that all who are interested in the advancement of natural history will collect and forward whatever objects their particular localities may afford, with a view to facilitate the researches of the illustrious author of *Horse Entomologicæ*. Mr. Macleay writes from London, 12th August, 1838—"I am now on the eve of embarking for Sydney, where I intend to remain for the next three or four years, and what I would ask of you is to exchange invertebrated animals, collected in India, as the Annulida, Annulosa, Cirrepedes, Radiata, and Acrita for other objects collected in New Holland; Insects, Spiders, and Crustacea of India I at present desire above all; and shall feel obliged by any notes on their metamorphosis or economy. With regard to such notes, I need not say I shall bear in mind the axiom "*Suum cuique*," if you will point out your particular *desiderata* in natural history I will endeavour to add to your collections."

Mr. Swainson also writes as follows—"At present I am engaged in Ichthyological volumes; but as these will be published before you would have time to render me any



with Indian species collected by Messrs. Duvaucel, Jaquemont, and De-Lessert, but I doubt if any of our British museums contain many of the commonest species of the Ganges.

Natural history is now assuming a station so important in the highest scale of intellectual pursuits, that any remarks at all calculated to impress on the minds of those who are connected with missions into new countries a lively sense of the interest that attaches to its most minute details, will not, we may be assured, be taken amiss. Information however carefully collected on such occasions as those referred to, becomes comparatively useless when unaccompanied with specimens of the things to which it relates. We should ever recollect that the easiest and best way to promote our own fame, and contribute at the same time to the advancement of natural history, is by making collections, nor are we without examples of the highest awards having been, though somewhat prematurely, conceded to collectors. Nevertheless, to render collections of the highest degree of real value in the present advanced state of science, those who make them should gather at the same time as much information as possible regarding the circumstances under which the various objects comprised in them live, or

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assistance, I will rather entreat your aid in the class of Insects which will next succeed in the 'Cabinet of Natural History.' My cabinet is remarkably deficient in the entomology of India, particularly among the smaller and less showy species. The best way of preserving Beetles or coleopterous insects as well as spiders is by putting them into spirits, all other insects should be stuck upon cork." Common bazar spirits answers the purpose of preserving insects very well, if it be strong enough to burn, which it would be well to try always before trusting to it, and instead of cork remarkably light and convenient trays may be made of a common species of *Aeschynomene*, called in Bengal *Sola*, and may be made, so that a number of them fit into a box. The paste with which the *Sola* is fastened might be poisoned, and a little camphor rolled up in thin paper, placed in each tray as a security against ants. I shall be happy to afford my aid to any friends of science in India, by forwarding any collections that may be entrusted to me for the eminent persons who have applied to us.

occur ; and it is in this that the intelligence of the naturalist may be best and most profitably displayed during his journies in new countries.

53. The following tabular view of the distribution of *Cyprinidæ*, though avowedly imperfect, will serve to show how the leading groups are generally dispersed. Cirrhins, for instance, appear to be peculiar to India, or at least to the tropical parts of Asia, and the Catastoms to America ; while both are represented in Europe by the true Carps. From the number of Gangetic species, the Barbels like the Cirrhins would seem to have their metropolis in India, from whence the genus is extended over the Caspian Sea, and the Nile into Europe.

The Gonorhynchs would also seem, as a group, to be natives of the East, one species only having been found in South Africa, none in Europe, and eleven in India.

The greater part of the *Sarcoborinæ* are probably also Eastern fishes, with the exception of the Breams and Lenciscs, although some of the European forms set down under the latter genera may be found to belong either to the Perilamps or Opsarions.

The small sub-genera of *Pæcilia* appear to be equally distributed in all parts of the world, one having been already found in Africa, two species in India, where a few more may be expected, seven species in America, and seven in Europe ; but in every case the species of one continent have been found to be distinct from those of another.

The Loaches (*Cobitis prop. Lin.*) afford another instance of the concentration of numerous species in India, while three only are found in Europe, and none whatever in America. The annexed table exhibits the general distribution of the family.

GENERAL VIEW OF THE DISTRIBUTION OF CYPRINIDÆ.

				ASIA.									
FAMILY,	SUB-FAM.	GENUS.	SUB-GEN.	—EUROPE,	—AMERICA,	—INDIA,	—CHINA,	—CASPIAN,	—AFRICA,	—UNCERTAIN,	TOTAL.		
CYPRINIDÆ Cuv.	PÆONOMINÆ McClell.	Cirrhinus Cuv.	..	..	—	—	13	—	—	—	13		
			Labeo Cuv.	..	—	2	1	—	—	1	5		
		Catastomus Leseur,	..	..	..	19	—	—	—	1	1	19	
		Barbus Cuv.	..	..	..	4	—	11	—	2	1	18	
			Oreinus McClell.	..	—	—	4	—	—	—	—	4	
		Cyprinus prop. Cuv.	..	..	6	—	4?	4?	—	—	—	14?	
		Gobio Cuv.	..	..	..	2	—	16	—	—	—	18	
			Tinca Cuv.	..	..	1	—	—	—	—	—	1	
		Gonorhynchus Gron.	..	..	..	—	—	10	—	—	1	11	
	SARCOBORINÆ McClell.	Systemus McClell.	..	..	..	—	—	12	—	—	—	12	
			Abramis Cuv.	..	..	5	1	1	—	—	—	7	
		Rhodeus Agass.	Fossil Genera in the lacustrine deposit of Oeningen.										
		Apilus Agass.											
		Perilampus McClell.	..	..	..	—	—	12	—	—	—	12	
		Leuciscus Klein.	..	..	..	13?	4?	9	—	—	—	26?	
		Opsarius McClell.	..	..	..	—	—	12	—	—	—	12	
		Pæcilia McClell.	Pæcilia prop. Schn.	..	..	—	4	—	—	—	—	—	4
			Lebias Cuv.	..	..	..	1	—	3	—	—	—	4
			Fundulus Lacèp.	..	..	5,	2	—	—	—	—	—	7
			Molinesia Leseur,	..	..	—	1	—	—	—	—	—	1
	Cyprinodon Lacèp.		..	..	2	4	—	—	—	—	—	6	
		Aplochelus McClell.	..	..	—	—	3	—	—	—	—	3	
	APALOPTERINÆ McClell.		Anableps Bl.	..	..	—	—	—	—	1	—	1	
		Platycara McClell.	..	..	..	—	—	3	—	—	—	3	
		Psilorhynchus McClell.	..	..	..	—	—	2	—	—	—	2	
		Cobitis Lin.	Cobitispropria McClell.	..	..	3	—	12	—	—	—	—	15
			Schistura McClell.	..	..	—	—	11	—	—	—	—	11
				42	37	139	4	2	41	229			

The American species of this family referred to in the *Regné Animal*, only amount to thirty-three, but Dr. Richardson in his report on North American Zoology mentions nearly as many more, imperfectly indicated by Rafinesque Smaltz, and other writers as belonging to the rivers and lakes of the new world\*;

\* I have not yet seen the volume of *Fauna Boreali Americana* by Dr. Richardson, which is devoted to Ichthyology, the volume on Birds being the only part of that important work which has reached India.

still however the preponderance of species in favour of India is so remarkable, that it is only by extending our consideration to other genera of the order *Malacopterygii abdominales* that we find the equilibrium restored in the distribution of fresh-water fishes. Thus the *Salmonidæ* which form a large proportion of that order in the rivers of both Europe and America, are in India quite unknown, not one species of that extensive family having yet been found in this country, where the blank appears to be filled up by the excessive development of the *Cyprinidæ*.

54. One species of Tench,\* four Leuciscs,† and one Gudgeon,‡ are enumerated among the fossils of Oeningen by M. Agassiz, who also describes two new genera § *Rhodeus* and *Apius*, nearly allied to, but distinct from the Perilamps and Systoms. They are distinct from the first, by the dorsal and ventral margins being equally arched, and the caudal and anal fins being less developed; and from the second, by the absence of spines in either of the latter fins; both belong however to *Sarcoborinæ*, and will serve to render that group far more complete than it appeared to me to be before I saw M. Agassiz's splendid work. Two fossil species of *Cobitinæ* are also found in the same locality, one of these, *C. cephalotus* Agass. belongs to *Schistura*. The marlstone in which these remains are found is justly considered by M. Agassiz to be a lacustrine deposit, and supposed to be coeval with the molasse of Switzerland and the sand stone of Fontainbleau, and consequently to correspond with the miocene or early tertiary period.

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\* *Tinca leptosoma*, Agass. *Recherches sur les Poissons Fossiles*, vol. v. t. 51.

† *Leuciscus papyraceus*, Agass. V. t. 36. *L. leptus*, Agass. V. t. 57. *L. pusillus* id. l. c. *L. œningensis* id. and *L. heterurus* id. l. c.

‡ *Gobio analis*, Agass. t. 57

§ *Rhodeus elongatus*, Agass. t. 54. and *R. latior* id. l. c. Of the genus *Apius*, M. Agassiz describes *A. gracilis*, and *A. brongiarti*, V. t. 55.; but the latter as well as *Leuciscus papyraceus* are from the lignites of Mènat.

55. That the external covering of animals indicates the medium in which they live, we know by the hairy coat of the *Mammalia*, the feathers of birds, and the scales of fishes and *Amphibia*. Nevertheless there are several families of fishes without scales, and many terrestrial *Mammalia* that are supplied with them instead of hair. In the naked fishes the body is defended by a copious oily mucous, which saves it no less effectually than scales from the abrasive influence of the dense medium through which they are destined to move, while their habits and form render the necessity for a scaly armour less essential to their safety, being capable of concealing themselves from enemies in sands and mud, as the Rays (*Raia*) and Eels, (*Muraena*), or are of such a formidable character as to render any security against the injuries of their class unnecessary; such are the *Squallidæ* or sharks, which may be said to be predominant among the fishes of the ocean, and the *Siluridæ* which maintain a corresponding place in fresh-water lakes and rivers. Notwithstanding this diversity, M. Agassiz has turned the external covering of fishes to a happy account in the study of fossil species, of which the scales alone are often the only vestiges that remain; thus a knowledge of eight hundred extinct species has been attained that could not have been characterized by ordinary means. Although the researches of M. Agassiz have added largely to the science of zoology, they have done still more if possible for geology, by "introducing a new element" into our calculations;\* no one however is more aware than M. Agassiz himself, of the error into which some are led in supposing the lepidermal system to be based on principles that are in any way at variance with the natural classification of animals. By that system M. Agassiz has extended our knowledge of the natural characters of species, and introduced to the calculations of the zoologist as well as geologist, a new element by which we must be guided in the study of fossil fishes, rather than a principle opposed to the classification of these or other animals according to their structure and habits.

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\* Dr. Buckland's Brid. Treat. p. 270.

**Classification**  
OF  
**INDIAN CYPRINIDÆ.**

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*Cyprinidæ constitute the first family of the second order of osseous fishes named in the Regne Animal, "Malacopterygii Abdominales," from their ventral fins being placed behind the pectorals, without being attached to the bones of the shoulder.*

CHAR. *One dorsal fin, stomach without cæcal appendages, branchial membrane with few rays.*

1. SUB-FAM.—PÆONOMINÆ.\* J. M.

CHAR. Mouth slightly cleft, either horizontal or directed more or less downward. The stomach is a lengthened tube continuous with a long intestinal canal. Colours plain. Three rays in the branchial membrane.

OBS. They occur only in fresh water, and comprise a large proportion of the fishes of lakes and rivers, more especially those that are of economical importance. Their food consists chiefly of confervoid plants and other productions of the vegetable kingdom.

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\* From *Poionomos*, that feeds on herbs.

## I. GEN.—CIRRHINUS.

CHAR. Lower jaw composed of two short limbs loosely attached together in front, where instead of a prominent apex, there is a depression ; lips soft and fleshy with four cirri,\* dorsal without spinous rays.

OBS. This genus would seem to be represented in America by the *Catostomi* of Leseur, and in Europe by *Cyprinus proprius*, Cuv. In India it affords several of the most favourite, abundant, and wholesome species.

*Spec. C. macronotus*, J. M. t. 41. f. 1.

Length of the head to that of the body as one to four ; forty-one scales along the lateral line, and thirteen in an oblique line from the base of the ventrals to the dorsum. D.23 : P.16 : V.9 : A.7 : C. 19.

HAB. Assam and North-eastern parts of Bengal, where it attains from two to three feet in length.

*Spec. C. nandina*, Buch. P. G.† t. 8. f. 84.

Length of the head to that of the body as one to three ; forty-four scales along the lateral line, and twelve in an oblique line from the base of the ventrals to the dorsum. D.26 : P.16 : V.9 : A.7 : C.19.

HAB. Bengal and Assam.

*Spec. C. calbasu*, Buch. P. G. t. 2. f. 33.

Length of the head to that of the body as one to four and a half ; forty-two scales along the lateral line, and fourteen in an

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\* I am not sure as to cirri forming any very valuable character of a natural genus. The length of the dorsal fin certainly does not ; in the first species it is as long as in the Carp.

† P. G. These initials refer to Buchanan's work on Gangetic Fishes.

oblique line from the base of the ventrals to the dorsum. D.15 : P.17 : V.9, or 10 : A.8 : C. $\frac{10}{9}$ .

*Variet.* Forty-two scales along the lateral line, and fifteen in an oblique line from the base of the ventrals to the dorsum. D.16 : P.15 : V.9 : A.5 : C. $\frac{9}{10}$ .

HAB. Bengal and Assam.

*Spec. C. rohita*, Buch. P. G. t. 36. f. 85.

Length of the head to that of the body somewhat less than one to three; forty-two scales along the lateral line, and twelve in an oblique line from the base of the ventrals to the dorsum. D.15 : P.16 : V.9 : A.7 : C. $\frac{10}{9}$ .

*Variet.\** t. 41. f. 2. Forty-three scales along the lateral line, and thirteen in an oblique row from the base of the ventrals to the dorsum. D.15 : P.16 : V.9 : A.8 : C.20.

HAB. Bengal and Assam.

*Spec. C. gonius*, Buch. P. G. t. 4. f. 82.

Scales minute; snout muscular and perforated by numerous mucous pores. D.15 : P.17 : V.9 : A.7 : C.19.

HAB. Bengal and Assam.

*Spec. C. nancar*, Buch. P. G. p. 299.

Sub-operculum rudimentary, and concealed beneath the integuments. D.20 : P.18 : V.9 : A.8 : C.19.

HAB. North-eastern parts of Bengal.

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\* This fish attains a large size in Assam, and is probably the true *Ruee* of the natives. That which is figured by Buchanan is as far as I have seen a small fish, though the larger kind which I have figured would seem to be the one he has described. This as well as the preceding species present so many varieties, probably the result of artificial means resorted to for their propagation, from their value as an article of food, that it is difficult to define their true characters.



The following three species have a black spot at the base of the caudal, and the dark colour of the back descends in fasciated points on the sides, thus indicating a relation with the *Sarcoborinæ*; but until the nature of this relation be determined, and their habits and structure known, I place them with the *Cirrhins*. I only know them by Buchanan's figures and descriptions.\*

*Spec. Cyp. morula*, Buch. P. G. Pl. xviii, f. 91.

Length of the head equal to the altitude of the body, and to a fourth of the length; lips pendulous, the hinder fimbriated.  
D.13 : P.16 : V.9 : A.8 : C.19.

HAB. Ponds in Bengal.

*Spec. Cyp. joalius*, Buch. t. 42. f. 6. β†

Head large and very blunt, mouth low and horizontal.  
D.12 : P.—? V.9 : A.8 : C.—?

HAB. North-eastern parts of Bengal.

*Spec. Cyp. dero*, Buch. P. G. t. xxii. f. 78.

Only two cirri. Head oval and blunt, snout prominent and rough, lips smooth-edged. D.13 : P.18 : —? V.9 : A.7 : C.19.

HAB. Bramaputra.

#### SUB-GEN.—LABEO.

CHAR. Structure and habits agree with those of the *Cirrhins*, but cirri are wanting, or very minute.

OBS. The last species would seem to be a *Catastomus*, and the two first to be very nearly allied to each other, and to differ chiefly from *C. gonius*, Buch.

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\* To these may be added for the present *Cyp. pausio*, Buch. P. G. 317. t. 42. f. 4 β. It seems to differ from them merely in being without cirri.

† This sign β, denotes that the figure given is from Buchanan's collection.

in being without cirri. They correspond with the species named by Buchanan, *Cyp. curchius*, *C. cursa*, and *C. cursis*, but I cannot altogether reconcile them with his descriptions; they appear to me to be varieties resulting from domestication.

*Spec. Cyp. curchius*, Buch. t. 40. f. 3.

Scales minute and disposed so as to indicate longitudinal stripes, lips fleshy and fimbriated, seventy-eight scales along the lateral line, and thirty from the base of the ventrals to the dorsum. D.17 : P.16 : V.9 : A.7 : C. $\frac{10}{9}$ .

HAB. Bengal and Assam.

*Spec. Cyp. cursis*,\* Buch. t. 38. f. 3.

Snout thick and projecting, eighty-three scales on the lateral line, and about twenty-seven across the body from the base of the ventrals to the dorsum. D.16 : P.17 : V.9 : A.7 : C. $\frac{10}{9}$ .

HAB. Assam and Bengal.

*Variet. Cyp. cursa*, Buch. t. 38. f. 2.  $\beta$

Scales and fin rays the same as in *C. curchius*, but the back is more abruptly arched, and the abdominal margin is straight to the anal.

*Spec. C. dyocheilus*,† J. M. t. 37. f. 1.

*Goreah* of the Assamese.

Head long, opercular plates covered with thick integuments, snout muscular, forty-four scales along the lateral line,

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\* This variety had been figured from a dried specimen and transferred to stone, before I found in Buchanan's collection a most excellent drawing of it.

† So called from the pendulous structure of the snout descending so as to form the appearance of a second lip.

and thirteen in an oblique line from the base of the ventrals to the dorsum. D.12 : P.18 : V.9 : A.8 : C.19.

HAB. Assam, where it usually attains two feet and upwards in length.

## II. GEN.—BARBUS.

CHAR. Lower jaw composed of two lengthened limbs, united in front so as to form a smooth narrow apex. Dorsal short preceded by a strong spine, lips hard, four cirri, intermaxillaries protractile.

Obs. Species of this genus inhabit the Caspian Sea, the Nile, and several of the rivers of Europe, generally confined to clear water. The comparative shortness of the intestinal canal proves them to be less exclusively herbivorous than any other fishes of the same sub-family. The Indian species, indicated in the *Regne Animal*, all belong to other genera.

*Spec. B. hexastichus*,\* J. M. t. 39. f. 2.

*Cyp. tor*, Buch. P. G. 305.

*Lobura* of the Assamese.

Length of the head to that of the body as two to seven, twenty-five scales along the lateral line, and six in an oblique row from the base of the ventrals to the dorsum. D.11 : P.17 : V.9 : A 8 : C.19.

HAB. Great rivers in the plains of India. Ordinary length from one and a half to three feet.

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\* From the scales forming six rows along the sides.

*Spec. B. progeneius*,\* J. M. t. 56. f. 3.

*Cyp. tor*, Buch. Coll.

Length of the head to that of the body as one to three, twenty-six scales along the lateral line, and six in an oblique row from the base of the ventrals to the dorsum, with a large cellular appendage to the apex of the lower jaw. D.12: P.16: V.9: A.7: C.19.

HAB. Great rivers in the plains of India. Ordinary length from  $1\frac{1}{2}$  to 3 feet.

*Spec. B. macrocephalus*, J. M. t. 55. f. 2.

*Bura heta* of the Assamese.

Length of the head to that of the body as two to five, twenty-seven scales along the lateral line, and six in an oblique line from the base of the ventrals to the dorsum. D.11: P.16: V.10: A.7: C. 19.

HAB. Rapids in Upper Assam. Ordinary length from 2 to  $3\frac{1}{2}$  feet.

*Spec. B. hexagonolepis*,† t. 41. f. 3.

*Bokar* of the Assamese.

Length of the head to that of the body as one to four, exposed surface of the scales hexagonal, twenty-seven scales along the lateral line, and seven in an oblique line from the base of the ventrals to the dorsum. D.12: P.16: V.9: A.7: C. $\frac{10}{5}$ .

HAB. Upper Assam. Ordinary length from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  feet.

\* From Προγενειος, that has a prominent chin or long beard; in allusion to the singular appendage to the lower jaw of this species by which it may be easily recognized.

† In allusion to the form of the exposed portion of the scales.

*Variet. Cyp. putitora*, Buch.

Head small and blunt, with eleven rays in the dorsal, attaining occasionally nine feet in length.\*

*Spec. B. megalepis*,† Hardw. Illust. t. 93.

*Cyp. mosal*, Buch.

*Maháseer* of the Hindus.

Body below uniformly arched at the insertion of the anal, length of the head to that of the body as one to three. D.13 : P.17 : V.9 : A.7 : C. $\frac{10}{9}$ .

HAB. Northern parts of Bengal. Length occasionally four or five feet.

*Spec. B. chelynoides*, J. M. t. 57. f. 5. Jour. A. S. vii. t. 56. f. 5.

Head large, lips thick and smooth, thirty-three scales along the lateral line, and nine in an oblique line from the base of the ventrals to the dorsum. D.10 : P.16 : V.9 : A.7 : C.18.

HAB. Mountain streams at Simla. Usual size about six inches in length. Dr. Macleod's Coll.

OBS. The following five species have the dorsal spine serrated behind. The first three are probably varieties of the same species.

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\* This fish I have been unable to identify with Buchanan's description, I may therefore have described it under another name; he says the head is blunt, oval, small, and smooth, which scarcely applies to either of the foregoing, in which the head is remarkably lengthened; that of *B. hexagonolepis* would come nearest to it, though some of the others seem to correspond more in other respects with the account given. Pisc. Gang. 303.

† From *Mega* large, and *lepis* a scale.

*Spec. Cyp. sarana*, Buch. P. G. p. 307.

*Cyp. kanta*, id Coll.

*Cyp. kunamo Russ?*

Head blunt, oval, and small, with a small bone at either side of the upper lip, green above, below silvery, scales large.  
D.10 : P.16 : V.9 : A.8 : C.19.

HAB. Ponds and rivers in India. Rarely attaining two feet in length.

*Spec. B. spilopholus*,\* J. M. t. 39. f. 4.

Head much compressed, cheeks and snout perforated with mucous pores, forty-eight scales along the lateral line, and seventeen in an oblique row from the base of the ventrals to the dorsum; each scale marked with a black spot at the base.  
D.11 : P.15 : V.9 : A.7 : C. $\frac{10}{9}$ .

HAB. Northern parts of Bengal.

*Variet. Cyp. chagunio*, Buch. P. G.

Scales large and spotted at the base, head much compressed, with numerous prominent mucous pores on its fore part.  
D.12 : P.17 : V.10 : A.8 : C.19.

HAB. Northern parts of Bengal.

*Spec. B. deliciosus*, J. M. t. 39. f. 3.

Head short and blunt, thirty-four scales along the lateral line, eleven in an oblique line from the base of the ventrals to the dorsum, with a bright gold coloured spot on each operculum.  
D.12 : P.16 : V.9 : A.7 : C.19.

HAB. Assam. Ordinary size about 10 inches in length.

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\* From *spilos* a spot, and *pholis* a scale.

*Spec. B. rodactylus*,\* J. M.

Fins red and orange, except the dorsal and upper lobe of the caudal, ten rays in the dorsal.

HAB. Lower Assam. Usual size about 5 inches in length.

SUB-GEN.—OREINUS,† J. M.—MOUNTAIN BARBELS.

CHAR. Head fleshy, mouth vertical, lower jaw shorter than the upper, snout muscular and projecting, furnished with cirri, dorsal preceded by a serrated spinous ray, scales small.

OBS. Intestinal canal and stomach form a tube equal to about four or five lengths of the body, including the head and caudal.

*Spec. O. guttatus*, J. M. t. 39. f. 1.

Head covered with thick integuments, branchial apertures small, sides and fins irregularly marked with brown spots, scales minute. D.10 : P.17 : V.11 : A.10 : C.20.

HAB. Mountain streams in Boutan, at an elevation of about 5000 feet, where it was found by Mr. Griffith.

*Spec. Cyprinus Richardsonii*, Gray. Hardw. Illust. t. 94. f. 2.

About eleven rays in the dorsal, and nine in the anal, back speckled with minute dots.‡

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\* *Rodaktylos*, literally rosy-fingered, in allusion to its red fins.

† From *Oreinos*, pertaining to mountains.

‡ This may probably prove to be *O. guttatus*.

*Spec. O. maculatus*, J. M. t. 57. f. 6. Journ. A. S. vii. t. 56. f. 6.

Mouth situated on the lower surface of the head, small shapeless spots irregularly distributed over the body, but not on the fins, scales minute. D.11 : P.18 : V.10 : A.5 : C.19.

HAB. Mountain streams at Simla, elevated between 5000 and 6000 feet, where it was found by Dr. Macleod.

*Spec. O. progastus*,\* J. M. t. 40. f. 4.

*Adoec* of the Assamese.

Muzzle fleshy and pointed, lips thick, somewhat pendulous and muscular, abdomen very prominent beneath the pectorals. D.12 : P.13 : V.10 : A.7 : C.19.

HAB. Rapids in Upper Assam, where it occasionally attains 18 inches in length, but its flesh is believed to produce vertigo and other alarming effects on those who use it.

### III. GEN.—CYPRINUS PROPRIUS.

CHAR. Body elevated, lower jaw short and rounded in front, lips hard, thick, and without cirri; dorsal long. Dorsal and anal usually preceded by spinous rays.

OBS. Only two species of this group have been as yet found in India, and one of these is without the dorsal and anal spinous rays.†

*Spec. C. semiplotus*, J. M. t. 37. f. 2.

*Sentooree* of the Assamese.

Head slightly depressed, with a single row of large mucous pores extending horizontally in front of the snout, back gibbous,

\* Προγαστως, that has a prominent belly.

† They have little affinity to each other; in *C. semiplotus*, the head is small and fleshy, so as to conceal the opercular plates, and in *C. catla*, it is large with naked opercula.



thirty-two scales along the lateral line, and ten in an oblique row from the base of the ventrals to the dorsum. D.27 : P.16 : V.9 : A.9 : C.19.

HAB. The rapids of the Bramaputra in Upper Assam. Usual size 1 foot to  $1\frac{1}{2}$  in length.

*Spec. C. catla*, Buch. P. G. t. xiii. f. 81.

Head large, forty-four scales along the lateral line, and fourteen in an oblique row from the base of the ventrals to the dorsum. Dorsal and anal without spinous rays. D.18 : P.18 : V.9 : A.8 : C.19.

HAB. Fresh water rivers and ponds in Bengal and Assam. Ordinary size from  $1\frac{1}{2}$  to 3 feet in length, but occasionally it is found twice that size.

#### IV. GEN.—GOBIO.

CHAR. The dorsal is placed over the ventrals, and like the anal is short and without spines, lower jaw shorter than the upper, and is either round or square in front, lips thin and hard, snout prominent.

OBS. The Gudgeons thus defined are a very natural group, remarkable for the extraordinary length of the abdominal canal. One of the only two indicated by Cuvier from Buchanan's species, is an Opsarion, a genus no less remarkable for the shortness of the abdominal canal than the Gudgeons are for its length; but as the distinctions on which the subdivisions of the family are here made, have not before been observed, we cannot be surprised that it should be repeated in the last edition of the *Regne Animal* from Linnæus, that the stomach of *Cyprinidæ* "is continuous with a short intestine." The following five species have each two cirri.

*Spec. Cyp. mrigala*, Buch. t. 38. f. 1. P. G. t. 6. f. 7.

Length of the head to that of the body as one to four and a half, depth of the body about one-fourth of the length, forty-four scales along the lateral line, and fourteen in an oblique line from the base of the ventrals to the dorsum. D.16 : P.17 : V.9 : A.8 : C.19.

HAB. Rivers and ponds throughout Bengal and Assam. Ordinary length two feet.

*Variet. Rewah* of the Natives, t. 58. f. 1.

Head less compressed than the body, upper jaw somewhat prominent, forty-three scales on the lateral line and thirteen in an oblique line from the base of the ventrals to the dorsum. D.15 : P.16 : V.9 : A.8 : C.19.

HAB. Ponds in the vicinity of Calcutta. Length from six to twelve inches.

*Spec. Cyp. curmuca*, Buch. Jour. Mys. III. t. 30.

Snout prominent and furnished with tubercles or mucous pores, lips smooth, and on each there is a small bone. D.11 : P.16 : V.9 : A.8 : C.18.

HAB. Rivers in Southern India, where it occasionally reaches three feet in length.

*Spec. Cyp. reba*, Buch. P. G. p. 280.

Head blunt, mouth small and directed downwards, lips soft. D.11 : P.17 : V.9 : A.8 : C.19.

HAB. Northern parts of Bengal and Behar, where it attains two feet in length.

*Spec. Cyp. angra*, Buch.

*Cyp. Hamiltonii*, Gray, Hard. Illust. t. 86. f. 1.

*Lasseem* of the Assamese.

Snout prominent and fleshy, thirty-five scales along the lateral line, and fourteen in an oblique line from the base of the ventrals to the dorsum. D.10 : P.10 : V.9 : A.8 : C.19.\*

HAB. Bramaputra.

*Spec. G. lissorhynchus*.† J. M. t. 55. f. 5.

*Cyp. acra*, Buch. *Cyp. cura*, id. P. G. p. 284.

Snout smooth and blunt without cirri, thirty-nine scales along the lateral line, and thirteen from the base of the ventrals to the dorsum. D.11 : P.16 : V.9 : A.8 : C.19.

HAB. Large rivers of Bengal and Assam. Usual length six to nine inches.

In the six following species the scales are thin and rough, and generally placed so that each scale is in the axis of the one immediately preceding or succeeding, and not in regular oblique rows as is usual in the family ; but this peculiarity is not so well marked in some species as in others. They are all without cirri. See *Cyprinus bangon*, Buch. t. 58. f. 2. β.

*Spec. Gobio isurus*, J. M.†

Snout smooth without cirri, scales in parallel rows, with a grey line between each row. D.11 : P.14 : V.9 : A.7 : C. $\frac{10}{9}$ .

HAB. Upper Assam, where it attains a size of eight or ten inches.

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\* Buchanan gives the fin rays as D.11 : P. 18, or 19 : V.9 : A.8 : C.19.

† From *lissor* smooth, and *rhynchus* the snout.

‡ From *isos* equal, and *oura cauda*.

*Spec. Cyp. boga*, Buch. P. G. t. 28. f. 80.

Snout perforated with numerous mucous pores, lower lip fimbriated, scales raised on either side of the base of the dorsal, lobes of the caudal slightly divided. D.12 : P.—V.9 : A.8 : C.—

HAB. Bramaputra. Usual length about nine inches.

*Spec. G. bicolor*, J. M. t. 40. f. 1.

Snout smooth, long, and rather pointed, lower jaw shorter than the upper, forty-two scales on the lateral line, thirteen in an oblique row from the base of the ventrals to the dorsum. Blue above, beneath silvery, pectorals small. D.12 : P.16 : V.9 : A.7 : C.19.

HAB. Rivers on the northern side of Assam. Griff. Coll.

*Spec. G. anisurus*,\* J. M. t. 40. f. 2.

Snout blunt, lower jaw shorter than the upper, lips hard and smooth, thirty-nine scales along the lateral line, and thirteen in an oblique row from the base of the ventrals to the dorsum, lower lobe of the caudal longer than the upper. D.12 : P.17 : V.9 : A.7 : C. $\frac{9}{10}$ .

HAB. Upper Assam. Griff. Coll.

*Variet. Cyp. bata*, Buch. P. G. p. 383.

Upper lobe of the caudal longer than the lower, with an ill defined transverse bar, ventrals smaller than the pectorals. D.12 : P.17 : V.9 : A.8 : C.19.

HAB. Rivers and ponds in Bengal, where it attains a foot in length.

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\* From *anisos* unequal, and *oura* a tail.

*Spec. G. limnophilus*,\* J. M. t. 55. f. 3.

Scales in parallel rows, thirty-six in each row, and twelve across the body. D.10 : P.19 : V.9 : A.7 : C.19.

HAB. Ponds in Bengal. Length  $12\frac{1}{2}$  inches.

In the remaining species the scales are as usual in oblique rows.

*Spec. Cyp. pangusia*, Buch. t. 42. f. 1.  $\beta$  †

Snout fleshy, porous, and prominent, forty-one scales along the lateral line, and fifteen across the body ; lips fimbriated. D.14 : P.18 : V.9 : A.7 : C.19.

HAB. Bengal, where it attains a span in length.

*Spec. Cyp. ariza*, Buch. Jour. Mys. 111. t. 31.

Snout and under lip smooth, twelve rays in the dorsal ; in other respects it resembles the last.

*Spec. G. ricnorhynchus*, J. M. t. 55. f. 1.

Snout thick and wrinkled, forty-three scales along the lateral line, and ten across the body from the base of the ventrals to the dorsum. D. 12 : P. 17 : V. 9 : A. 7 : C. 19.

HAB. Northern parts of Bengal, here it was found by Mr. Hodgson.

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\* From *Λυμνη* a swamp or lake, and *φίλος* to love or frequent.

† Its form is not so slender as represented in the figure. Buchanan also gives seventeen rays to each pectoral, and eight to the anal.

*Spec. G. malacostomus.\** J. M.

*C. falcata.* Gray Hardw. Illust. t.—?†

*Nepura* of the Assamese.

Snout thick, fleshy, and perforated with numerous large mucous pores, margins of the lips double and fimbriated. D. 12: P. 16: V. 9: A. 8: C. 19.

HAB. Rapids in Upper Assam. Length from six to twelve inches. Mr. Griffith's Coll.

#### V. GEN.—GONORHYNCHUS.

CHAR. Mouth situated under the head, which is long and covered with thick integuments, body long and sub-cylindrical, snout perforated by numerous mucous pores, dorsal and anal short, opposite, and without spines. The intestine and stomach form a continuous tube about eight lengths of the body.

OBS. This genus hitherto rested on a single species long since found at the Cape of Good Hope, but the *Garræ* of Buchanan chiefly belong to it, as well as several species which have since been found in India.

The first three species are without cirri.

*Spec. G. gobioides*, J. M. t. 43. f. 1.

*Herilwa* of the Assamese.

Altitude of the body to its length as one to four, thirty-seven scales along the lateral line, and nine in an oblique row

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\* From *μαλακος* soft, and *στομος* the mouth.

† This plate is not numbered in Hardwicke's Illustrations, nor is it included in the list of plates prefixed to the volume.

from the base of the ventrals to the dorsum. D.10 : P.15 : V.9 : A.7 : C.19.

HAB. Bramaputra, in Assam. Length about a span.

*Spec. G. petrophilus*, J. M. Jour. Asiat. Soc. iv. t. 1.

Scales very minute, body and head long, eight rays in the dorsal.\*

*Spec. G. rupiculus*, J. M. t. 43. f. 4. 5.

Snout thick and smooth, pectorals rounded;† fins short, and the membrane in which their rays are enclosed thick and opaque; thirty-five scales along the lateral line, and nine in an oblique row across the body. D.8 : P.10 : V.9 : A.6 : C.20.

HAB. Mishmee mountains. Length about two inches. Griffith's Coll.

*Spec. G. bimaculatus*, J. M.

Snout warty, porous, and divided by a fissure, without cirri; a black spot at the base of the caudal, lower lobe of the caudal longer than the upper, thirty-four scales along the lateral line and eight rows between the ventrals and dorsum; pectorals and ventrals lanceolate. D.9 : P.13 : V.9 : A.7 : C. $\frac{9}{10}$ .

HAB. River Laeeh at the foot of the Mishmee mountains, where it was found by Mr. Griffith.‡

\* The habits of this species are fully described, but we want to know more of its specific characters.

† The form of the pectorals is not accurately represented in the figure.

‡ Also at the foot of the Nipal mountains, where Mr. Hodgson appears to have found a specimen now in the Asiatic Society's collection. In this, however, the lobes of the caudal are of equal length. It is so like the succeeding variety that I have thought it unnecessary to figure it separately.

*Spec. Cyp. lamta*, Buch. t. 43. f. 2. β P. G. p. 343.

*Cyp. godiyava*, id. Coll.

Four very short cirri, pectorals and ventrals lanceolate, and a black spot on either side of the tail, snout thick and warty. D.10 : P.13 : V.9 : A.7 : C.19.

HAB. Northern parts of Bengal, where it attains  $2\frac{1}{2}$  or three inches in length.

*Spec. G. gotyla*, Gray, Hardw. Illust. t. 88. f. 3.

Snout thick, and divided by a deep transverse fissure in which numerous large mucous pores are situated, a fleshy pendulous point at each corner of the mouth ; four minute cirri.

HAB. Mountains of India.

*Spec. G. fimbriatus*, t. 43 f. 3. β

*Cyp. sada*, Buch. P. G.

Four cirri little shorter than the head, pectorals and ventrals falcate. D.10 : P.—? V.9 : A.7.

HAB. Northern parts of Bengal, where it attains a few inches in length.

The remaining three have each two small cirri.

*Spec. G. macrosomus*,\* t. 43. f. 7. β

*Cyp. latius*, Buch. P. G. p. 346.

Depth of the body to the entire length as one to six, two cirri, scales small. D.11 : P.13 : V.9 : A. 7 : C.20.

HAB. Northern parts of Bengal.

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\* From Μακρος long, σωμα the body.



*Spec. Cyp. gohama*, Buch. P. G. p. 346. t. 43. f. 6.β

*Cyp. dyangra*, id. Coll.

Is shorter in proportion, and more arched above and below than the former, and has eight rays in the anal.

HAB. Northern parts of Bengal.

*Spec. G. brachypterus*, J. M.

Lower surface of the head flat with a cartilaginous zone behind the mouth like *G. rupiculus*,\* a few irregular pores on the snout, thirty-six scales on the lateral line and seven rows across the body.

HAB. Mishmee mountains. Griff. Coll.

## II. SUB-FAM.—SARCOBORINÆ,† J. M.

CHAR. Mouth directed upwards, or more widely cleft and horizontal, with a bony prominence more or less distinct, serving as a prensile tooth on the symphysis of the lower jaw; colours bright, disposed in spots and streaks, or evincing an uniform lustre. The stomach is a lengthened sack ending in a short abdominal canal. Three rays in the branchial membrane.

OBS. Like the *Pæonominæ*, they occur only in fresh water, and although they are generally small, yet from the vast numbers in which they abound in every pond they must be considered as of considerable importance.

\* It also agrees with that species in the form of its fins; the presence of two very minute cirri being my chief reason for separating them, I have not thought it necessary to give a figure.

† From *Σαρκοβορος*, carnivorous.

## I. GEN.—SYSTOMUS.\* J. M.

CHAR. Intermaxillaries protractile, dorsal and anal short, the former opposite to the ventrals and preceded by a spinous ray; body elevated, and marked by two or more distinct dark spots, or diffuse spots either on the fins or opercula, prominence on the apex of the lower jaw obscure.

OBS. In the following species the depth of the body is equal to about half the length, and the spinous ray of the dorsal is serrated behind, except when otherwise described.

*Spec. S. immaculatus*, J. M. t. 44. f. 5.

Four cirri, a slight golden tinge on the opercula, fins dark, thirty-two scales on the lateral line and ten in an oblique line from the base of the ventrals to the dorsum. D.11 : P.15 : V. 9 : A.7 : C.19.

HAB. Small streams with sandy bottoms in Assam, and probably occasionally in the large rivers.

*Spec. S. chrysosomus*, J. M.

Two minute cirri, thirty-five scales along the lateral line; opercula and suborbital plates stained with gold yellow. D. 10: P.16 : V.8 : A.8 : C.19.

HAB. Bengal. Length about six inches.†

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\* From *Systomos*, that has a narrow mouth.

† From a figure in Capt. Burnes' Collection, this species would also seem to be an inhabitant of the Indus; it is nearly allied to the preceding species, and is probably a variety only.

*Spec. S. tetrapagus*, J. M. t. 44. f. 3.

*Cyp. titius*, Buch. (?) P. G. 315.

No cirri, a black spot on either side behind the opercula and another at the end of the tail. D.10 : P.12 : V.9 : A.7 : C.20.

HAB. Bramaputra and ponds in Assam.\*

*Spec. S. chrysopterus*, J. M.

No cirri or spots, pectorals and ventrals red, twenty-three scales along the lateral line and eight in an oblique line from the base of the ventrals to the dorsum. D.9 : P.13 : V.9 : A.7 : C.18.

HAB. Bengal and Assam, and is numerically of great importance, though its size is small.†

*Spec. S. pyropterus*, J. M. t. 44. f. 1.

No cirri, fins red, a black spot over the situation of the anal, twenty-four scales along the lateral line, and nine in an oblique row from the base of the ventrals to the dorsum. D. 9 :

P.12 : V.9 : A.7 : C.19.

HAB. Very numerous in ponds in Upper Assam.

*Spec. C. sophore*, Buch. P. G. t. 19. f. 86.

Without cirri, spinous ray of the dorsal smooth behind, a black spot on the tail and another on the dorsal, opercula yellow. D.10 : P.14 : V.9 : A.7 : C.19.

HAB. Bengal.

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\* *Cyprinus ticto*, Buch. P. G. t. 8. f. 87, is nearly allied to this species, but shorter.

† As I suspect this to be a variety of *S. pyropterus* I have not thought it unnecessary to add a figure.

*Spec. Cyp. chola*, Buch. t. 58 f. 3.  $\beta$

Two cirri, a yellow spot on the opercula, and a black spot on the middle of the tail; the spinous ray of the dorsal smooth behind. D.10 : P.13 : V.9 : A.7 : C.19.

HAB. Northern parts of Bengal.

*Spec. S. gibbosus*, t. 44. f. 7.  $\beta$

*Cyp. terio*, Buch. P. G. 313. *Cyp. teripungti*, id. Coll.

Back abruptly arched, below straight, no cirri, dorsal spine smooth behind, with a black spot near the middle of the side. D.11 : P.13 : V.9 : A.8 : C.19.

HAB. Northern parts of Bengal.

All the remaining species but the last two are furnished with a dorsal spine serrated behind; none of them have cirri.

*Spec. Cyp. conchoniis*, Buch. t. 44. f. 8.  $\beta$

A black spot on the lateral line over the insertion of the anal, fins pale, dorsal spine serrated behind; the fin rays are D.10 : P.10 : V.9 : A.8 : C.19.

HAB. Northern parts of Bengal.

*Spec. Cyp. gelius*, Buch. t. 44. f. 4.  $\beta$

An irregular black spot or streak at the base of all the fins but the pectorals; abdomen silvery, bounded behind with a dark streak, twenty-five scales on the lateral line, and eight in an oblique row from the base of the ventrals to the dorsum. D.10 : P.13 : V.9 : A.7 : C.19.

HAB. Bengal; and scarcely attains two inches in length.\*

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\* It is not improbable that as Buchanan gives eight rays to the ventrals, he may have described the following variety for the one figured.

A variety of this last species with twenty-three scales along the lateral line, and ten in an oblique row from the base of the ventrals to the dorsum, is common in swamps about the neighbourhood of Calcutta.

*Spec. S. leptosomus*,\* t. 44. f. 2.  $\beta$

*Cyp. phutunio*, Buch. P. G. 319.

*Cyp. phutunipungto*, id. Coll.

Twenty scales along the lateral line and seven across the body, a black streak over the pectorals on either side, and another over the anal, with an obscure streak in front of, and another behind the dorsal. D.10 : P.12 : V.8 : A.7 : C.19.

HAB. Bengal, where it attains about  $1\frac{1}{2}$  inches in length.

*Spec. Cyp. canius*, Buch. t. 44. f. 6.  $\beta$  P. G. p. 320.

*Cyp. ranipungti*, id. Coll.

Red. Abdomen silvery and diaphinous, base of the fins and body marked with dark spots. D.10 : P.8 : V.9 : A.7.

HAB. Bengal. Length about  $1\frac{1}{2}$  inches.

*Spec. S. malacopterus*, t. 44. f. 9.  $\beta$

*Cyp. cosuatis*, Buch. P. G. 338.

*Cyp. coswati*, id. C. D.

Back abruptly arched, no spine in the dorsal, which with the ventrals is marked with an irregular black stain. Twenty-three scales along the lateral line, and either five or six rows from the base of the ventrals to the dorsum. D.10 : P.15 : V.9 : A.7 : C.  $\frac{10}{9}$

HAB. Bengal, and is seldom above two inches in length.

---

\* From *leptos* small, and *σωμα* the body.

## II. GEN.—ABRAMIS.

CHAR. Body short and elevated, a short dorsal is placed opposite to the ventrals, colours plain, anal long.

OBS. One species only has hitherto been discovered in India.

*Spec. Cyp. cotis*, Buch. P. G. Pl. 59. f. 93.

Body silvery white, scales very small, a small black spot is situated at the base of the dorsal. The fin rays are D.10 : P.13 : V.10 : A.32 : C.19.\*

## III. GEN.—PERILAMPUS,† J. M.

CHAR. Head small, obliquely raised above the axis of the body ; dorsal placed opposite to a larger anal ; apices of the jaws raised to a line with the dorsum, which is straight ; the ventral margin is much arched ; sides usually streaked with blue ; fins without spinous rays.

OBS. In this genus the intestine is small, and very little longer than the body. The species all subsist exclusively on insects, which they seize by leaping above the surface. They vary from two to four inches in length.

In the first two species, the altitude of the body is equal to half its length.

*Spec. Cyp. devario*, Buch. P. G. t. 6. f. 94.

Back arched, sides marked with a single interrupted blue . streak. D.18 : P.10 : V.8 : A.18 : C.19.

HAB. Bengal and Assam.

---

\* Buchanan makes the fin rays D.10 : P.16 : V.12 : A.36 : C.19. the discrepancy depends on the difficulty of counting the rays in some of the fins of this small species.

† From Περιλαμπω to irradiate, or shine brilliantly.

*Spec. P. ostreographus*,\* J. M. t. 45. f. 3.

Back straight, sides marked with several blue streaks. D.12 :  
P.15 : V.8 : A.16 : C.19.

HAB. Assam.

In the next two species the altitude of the body is equal to a third of the length.

*Spec. P. perseus*,† J. M. t. 46. f. 5.

Pectorals and ventrals long, one blue streak on either side.  
D.19 : P.8 : V.5 (?) A.21 : C.—

HAB. Assam, and probably Bengal.

*Spec. P. guttatus*, t. 45. f. 4. β

*Cyp. laubuca*, Buch P. G. p. 260.

A small green or blue spot over the base of each pectoral,  
and another at the base of the caudal, on either side. D.10 :  
P.12 : V.7 : A.24 : C.—

HAB. Northern parts of Bengal.

In the following two, the first ray of each ventral is prolonged to half the length of the body.

*Spec. P. psilopteromus*,‡ t. 46. f. 4. β

*Cyp. loyukula*, Buch. Coll.

*Cyp. atpar*, id. P. G. p. 259.

Depth of body almost equal to half its length, much com-  
pressed, ventrals elongated, a narrow blue streak along the  
lateral line, D.9 : P. 11, or 12 : V. 5 : A. 25 : C.—

HAB. Bengal.

\* Οστρειογραφης, marked with purple streaks ; from οστρειον γραφω.

† *Perseos*, the Greek name of an unknown fish.

‡ From *Psilos* slender, *pteroma* the fin of a fish.

*Spec. Cyp. cachijs*, Buch. t. 46. f. 6.  $\beta$

*Cyp. kachki*, id. Coll.

Diaphinous, ventrals elongated. D.7 : P.8 : V.3 : A.26.

HAB. Sunderbuns, and southern parts of Bengal.\*

The following species have four cirri. In the two first the depth is equal to about a fourth of the entire length of the body.

*Spec. P. reticulatus*, t. 45. f. 1.  $\beta$

*Cyp. dangila*, Buch. P. G. p. 321.

Reticulated purple stripes on the sides, caudal almost entire.

D.13 : P.12 : V.7 : A.17 : C.20.

HAB. Rocky streams in Behar.

*Spec. P. striatus*, t. 46. f. 1.  $\beta$

*Cyp. rerio*, Buch. P. G. p. 322.

Dorsal round, four or five bright blue stripes on the sides.

D.8 : P.10 : V.7 : A.17 : C.18.

HAB. Bengal, particularly the Sunderbuns.

In the following three, the depth is equal to about a fifth of the entire length. They have each four cirri, and the anal is short.

*Spec. P. recurvirostris*, t. 46. f. 2.  $\beta$

*Cyp. jogia*, Buch. P. G. p. 326.

A dark blue stripe extended from the eyes to the caudal, apices of the jaws recurved. D.9 : P.12 : V.8 : A.7 : C.19.

HAB. Bengal, from Calcutta to Purnea.

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\* This is the smallest species of the group, being only about an inch in length.



*Spec. P. macropterus*, t. 46. f. 3.  $\beta$

*Cyp. sutiha*, Buch. P. G. p. 327.

Much compressed, diaphinous below the lateral line, caudal large, first ray of the other fins extended to a lengthened filament. D.8 : P.10 : V.7 : A.7 : C.19.

HAB. Gurruckpore district.

*Spec. P. thermophilus*, J. M.\* t. 54. f. 19.

Head very obliquely raised, green above, below silvery, thirty-one scales on the lateral line and seven rows across the body. D.8 : P.9 : V.8 : A.7 : C.20.

HAB. Found by Dr. Cumberland in Hot Springs at Pooree. Temperature of the Springs 110° Far.

#### IV. GEN.—LEUCISCUS.

CHAR. Dorsal and anal small, without spinous rays, head horizontal, mouth of moderate size, scales and opercula covered with a copious silvery pigment.

OBS. The stomach is capacious as well as the intestine, which is short, seldom exceeding the length of the body. The anal is generally smaller than the dorsal, and the mouth directed slightly upward. Seldom with cirri.

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\* I have here reserved the initials J. M. for species that have not before been described, or which I have been unable to refer to Buchanan's descriptions ; but I am responsible for all new specific names in this paper, whether such initials be attached to them or not. I may observe, however, that I have been more anxious to identify Buchanan's species than to describe new ones, and to reserve his names than to substitute others.

*Spec. Cyp. daniconius*, Buch. P. G. t. 15. f. 89.

A dark stripe extends over each side of the head along the lateral line to the caudal; lower jaw pointed, and received into a notch in the upper. D.9 : P.13 : V.9 : A.7 : C. 19.

HAB. Bengal, where it only attains about two inches in length.

*Spec. L. lateralis*, P. G. 328.

*Cyp. anjana*, Buch.

Two streaks on each side, jaws somewhat depressed, the lower jaw longer than the upper, pointed and received into a notch. D.9 : P.13 : V.9 : A.7 : C.19.

HAB. Northern parts of Bengal.

*Spec. L. dystomus*,\* J. M. t. 56. f. 4.

*Cyp. clanga*, Buch. (?) P. G. 281.

Two small cirri, forty scales along the lateral line, eleven oblique rows between the base of the ventrals and the dorsum. D.9 : P.15 : V.9 : A.7 : C. 19.

HAB. Bramaputra in Assam.

*Spec. Cyp. rasobora*, Buch. P. G. t. 2. f. 90.

Three prehensile knobs on the lower jaw, caudal tipt with black, twenty-five scales along the lateral line and seven across the body. D.9 : P.13 : V.9 : A.8 : C. $\frac{10}{9}$ .

HAB. Bengal and Assam.

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\* Δυστομος hard-mouthed.

*Spec. Cyp. mola*, Buch. P. G. t. 38. f. 92.

A lead-coloured streak along the lateral line, scales small and easily detached, depth equal to a third of the length.

D.9 : P.15 : V.9 : A.7 : C.19.

HAB. Ganges and Bramaputra.

*Spec. L. pellucidus*, J. M.

A lead-coloured streak along the lateral line, depth equal to a fourth of the entire length. D.8 : P.16 : V.9 : A.6 : C.19.

HAB. Ganges and Bramaputra.

In others the anal contains as many and even more rays than the dorsal, but they are short ; in these the mouth is horizontal.

*Spec. Cyp. apíatus*, Jaquem. Voy dans l'Inde. t. 15. f. 3.

*Spec. L. branchiatus*, J. M. t. 42. f. 5.

Scapulary and branchial plates present a broad silvery surface behind the opercula, forty-four scales along the lateral line, and ten in an oblique row from the base of the ventrals to the dorsum. D.8 : P.14 : V.9 : A.10 : C.18.

HAB. Assam and the northern parts of Bengal.\*

*Spec. Cyp. chedra*, Buch. Hardw. Illust. t. 87. f. 3.

Scapulary plates exposed, caudal extremity of the body recurved. The fin rays are, D.10 : P.14 : V.9 : A.11 : C.18.

HAB. Northern parts of Bengal.

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\* A variety of this species has a row of black dots crossing the rays of the dorsal, which with each ventral has nine rays.

*Spec. L. margarodes*,\* J. M.

Snout rather prominent, first suborbital plate extends to the mouth, scales small, lower lobe of the caudal rather longer than the upper. D.9 : P.15 : V.8 : A.8 : C.19.

HAB. Upper Assam, where it was found by Capt. Hannay.

*Spec. Cyp. morar*, Buch. P. G. t. 31. f. 75. *Chula* of the Assamese.

Suborbital plates extend to the corner of the mouth, scales large, loosely attached, and covered with a copious white pigment. D.10 : P.14 : V.8 : A.12 : C.19.

HAB. Bramaputra.

*Spec. Cyp. cocsu*, Buch. P. G. t. 3. f. 77.

Four cirri, suborbital plates extend to the mouth, several incomplete bars descend partially across the sides, forty-two scales along the lateral line, and eleven in an oblique row from the base of the ventrals to the dorsum. D.9 : P.13 : V.9 : A.10 : C.19.

HAB. Northern rivers of Bengal, where it attains a span in length.

*Spec. L. elingulatus*, J. M. t. 57. f. 4.

*Peril. elingulatus*, id. J. A. S. vol. vii. t. 56. f. 4.

No cirri, head high and compressed, snout blunt, forty-six scales on the lateral line, and eleven in an oblique row from the base of the ventrals to the dorsum. D.9 : P.13 : V.9 : A.10 : C.19.

HAB. Mountain streams at Simla. Dr. Macleod's Coll.

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\* *Μαργαρωδης*, resembling pearl. The scales of this species would afford abundant materials for the manufacture of mock pearl. There is a variety of this species with nine rays in the ventral, and eight in the anal fin.

## V. GEN.—OPSARIUS,\* J. M.

CHAR. Mouth widely cleft, body slender, and usually marked with transverse green streaks or spots, dorsal small without spines, and placed behind the middle, anal long, lower margin of the body more arched than the upper.

OBS. Intestine very short, and extends almost straight from the stomach to the vent.

The first three are silvery white, without bars or spots, and have the dorsal opposite to the commencement of the anal and the lower lobe of the caudal longer than the upper.

*Spec. O. pholicephalus*, J. M. t. 47. f. 2.

*Cyp. gora*, Buch. P. G. p. 263.

Pectorals long, ventrals small, scales extended on the crown over the situation of the eyes, dental hook very prominent. D.9 : P.13 : V.8 : A.17.

HAB. Assam and Bengal.

*Cyp. bacalia*, Buch. P. G. t. 8. f. 76.

Depth equal to a third of the length of the body, two lateral lines on each side. D.9 : P.12 : V.9 : A.16 : C.19.

HAB. All parts of India.

*Spec. O. leucerus*, J. M. t. 47. f. 3.

Depth equal to a fourth of the length. Ventrals very small. D.9 : P.13 : V.9 : A.14 : C.18.

HAB. Bengal and Assam.

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\* From *οψαριον*, *pisciculus*, a small fish.

*Spec. O. albulus*, J. M. t. 48. f. 10.  $\beta$

*Cyp. phulo*, Buch. P. G. p. 262.

Nape extends to the eyes, head short, lower lobe of the caudal somewhat longer than the upper. D.9 : P.11 : V.8 : A.20 : C.18.

HAB. North-western parts of Bengal.

The following two have a portion of the dorsal in front of the anal, and the depth equal to about a third of the length.

*Spec. O. cirratus*, t. 56. f. 5.  $\beta$

*Cyp. shakra*, Buch. P. G. p. 271.

Four cirri, branchial plates exposed behind the opercula, lower lobe of the caudal longer than the upper. D.9 : P.13 : V.9 : A.10 : C.20.

HAB. Kosi river.

*Spec. O. fasciatus*, t. 48. f. 9.  $\beta$

*Cyp. borna*, Buch. P. G. p. 268.

A longitudinal yellow streak, and about nine incomplete green cross bars on each side. D.9 : P.13 : V.9 : A.12 : C.19.

HAB. Ganges, Brainaputra, and Jumna.

In the following three, the depth is equal to about a fourth of the length ; the dorsal is placed opposite to the interval between the ventrals and anal ; the branchial plates exposed and broad.

*Spec. O. maculosus*, t. 47. f. 4.

*Cyp. tileo*, Buch. P. G. p. 276.

Apex of the lower jaw without a tooth but sharp, and received into a notch in the upper jaw ; two rows of oblong transverse spots, D.9 : P.14 : V.8 : A.15 : C. $\frac{8}{10}$ .

HAB. Ganges and Bramaputra.

*Spec. O. brachialis*, J. M. t. 48. f. 6.

Head short, pectorals removed backwards by the breadth of the branchial plates, sides marked with two rows of oblong transverse spots. D.9 : P.14 : V.9 : A.13 : C. $\frac{10}{9}$ .

HAB. Assam.\*

*Spec. Cyp. bendelisis*, Buch. Jour. Mys. 111 t. 32.

Ten incomplete bars on each side, two cirri, nine rays in the dorsal and eleven in the anal. D.9 : P.13 : V.9 : A.11 : C.19.

HAB. Assam and other parts of India.

In all the remaining species the body is long, the depth being equal to one-fifth of the length.

*Spec. O. gracilis*, t. 47. f. 1.

*Cyp. goha*, Buch. Hardw. Illust. t. 5. f. 3.

Head long, mouth cleft beyond the eyes, dorsal opposite to the space between the ventrals and anal, sides spotted. D.10 : P.13 : V.9 : A.12 : C.18.

HAB. Ganges and Bramaputra.

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\* I am not sure as to the accuracy of separating this from the last.

*Spec. O. megastomus*, t. 48. f. 5.  $\beta$

*Cyp. bola*, Buch. P. G. p. 274.

Head small, mouth cleft beyond the eyes, several transverse green bands on the sides. D.10 : P.16 : V.9 : A.11 : C.19.

HAB. Bramaputra.

*Spec. O. isocheilus*, t. 56. f. 1.  $\beta$

*Cyp. vagra*, Buch. P. G. p. 269.

Jaws of equal length, sides silvery, marked with ten minute transverse spots. D.9 : P.13 : V.9 : A.14 : C.16.

HAB. Ganges.

*Spec. O. anisocheilus*, t. 48. f. 8.  $\beta$

*Cyp. barila*, Buch. P. G. p. 267.

*Cyp. chedrio*, id. l. c.

Upper jaw more prominent than the lower, mouth rather small, incomplete bars on the sides. D.8 : P.14 : V.8 : A.13.

*Spec. O. latipinnatus*, J. M. t. 48. f. 7.

*Balisunderi* of the Assamese.

Sides marked with transverse green bars, dorsal opposite to the ventrals, and contains nine rays widely separated from each other, the first preceded by a short isolated ray.\*

HAB. Upper Assam.

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\* Further information is required regarding this species ; having lost the only specimen I had I am unable to add its specific characters more fully.



## SUB-FAM.—APALOPTERINÆ,\* J. M.

Consists of those genera, the species of which have either elongated cylindric bodies or flat heads, as the Loaches and *Pæciliæ*. They are without spinous rays in any of the fins, the intestine is short, and enveloped in a copious mucous secretion; three to six rays in the branchial membrane.

## I. GEN.—PLATYCARA,† J. M.

CHAR. Head flat, with the eyes placed on the upper surface, fins thick and opaque, pectorals large, anal small, caudal bifid, mouth without teeth and placed on the lower surface of the head, three rays in the branchial membrane.

OBS. The stomach and intestine form a continuous fleshy tube, not much exceeding the length of the body; they are found in elevated mountain streams.

*Spec. P. maculata*, t. 49. f. 1.

*Balitora maculata*, Gray. Hardw. Illust. t. 88. f. 2.

Obscure irregular spots on the body, and two rows of the same on the caudal. D.8 : P.17 : V.9 : A.6 : C.19.

HAB. Boutan mountains. Griff. Coll.

*Spec. Balitora Brucei*, Gray, t. 49. f. 1. Hardw. Illust. t. 88. f. 2.

Fins barred with dark streaks, body spotted.‡

\* Etym. *Απαλος* soft, and *πτερον* a fin or wing.

† For etymology, see page 246.

‡ This species, I believe, at present depends chiefly on a figure in the work referred to.

*Spec. P. nasuta*, J. M. t. 57. f. 2. J. A. S. vol. vii. t. 55. f. 2.

A deep depression on the snout between the eyes, thirty-four scales on the lateral line, and eight in an oblique row from the base of the ventrals to the dorsum. D.10 : P.16 : V.9 : A.6 : C.15.

HAB. Kasyah mountains. Griff. Coll.

## II. GEN.—PSILORHYNCHUS,\* J. M.

CHAR. Muzzle elongated and flattened, eyes placed on the edges of the head, mouth small and suctorial without cirri, opercula small, caudal bifid, dorsal opposite to the ventrals.

*Spec. P. sucatio* t. 50. f. 1. β

*Cyp. sucatio*, Buch. P. G. p. 347.

Eyes placed far back near the branchial aperture. D.9 : P.13 : V.9 : A.7 : C.19.

HAB. North-eastern parts of Bengal.

*Spec. P. variegatus*, 50. f. 2. β

*Cyp. balitora*, Buch. P. G. p. 348.

Diaphinous, silvery below, above spotted, one row of cloud-like spots on the back, and another on each side. D.10 : P.12 : V.9 : A.7 : C.18.

HAB. North-eastern parts of Bengal.

## III. GEN.—PÆCHILIA, J. M.

CHAR. Head flat, minute teeth inserted along the edges of the jaws, caudal entire ; from four to six rays in the branchial membrane.

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\* For etymology, see page 248.

OBS. This genus includes the *Pæcilia propria*, Schn. *Lebias*, Cuv. *Fundulus* Lacep. *Molinesia*, Leseur. *Cyprinodon*, Lacep. They are here reduced to sub-genera; and the following Indian sub-genus is added to the group\*.

SUB-GEN.—APLOCHEILUS,† J. M.

CHAR. Intermaxillaries fixed, apices of the jaws broad, flat, and directed upwards; five rays in the branchial membrane; fins transparent.

OBS. A short dorsal is placed opposite to the last ray of a long anal, the ventrals are very small; the intestine and stomach form together a small tube scarcely longer than the body.

*Spec. A. chrysostigmus*,‡ J. M. t. 42. f. 2.

A bright gold-like spot on the occiput, another in front of the dorsal; about twenty-eight scales on the lateral line, and nine rows between the ventrals and dorsum; a single uniform row of straight teeth. D.7: P.13: V.—: A.17: C.18.

HAB. Sunderbuns and ponds about Calcutta. Scarcely an inch in length.

*Spec. A. melastigmus*,§ J. M. t. 42. f. 3.

A black spot at the base of the dorsal, ventrals very minute, teeth slightly hooked and crowded at the sides of the mouth. D.7: P.10: V.—? A.22: C.18.

HAB. Tanks in Calcutta, and being scarcely an inch in length, is the smallest Indian species of the family.

\* In the Regne Animal, we have in this part of the family almost as many genera as species, while the whole of the important groups composing the *Pænominae* and *Sarcoborinae* are described as sub-genera.

† *Ἀπλος* simple or single and *χειλος* the lip.

‡ Etym. *chryson* gold, and *stigma* a mark.

§ From *melas* black, and *stigma* a spot.

*Spec. Esox panchax*, Buch. P. G. t. 3. f. 69.

A black spot on the dorsal, opercula covered with scales.

D.6 : P.16 : V.6 : A.14 : C.16.

HAB. Sunderbuns in Bengal, where it attains two inches in length.

There is still a fourth species, t. 55. f. 4. which I derive from Buchanan's collection of drawings, but cannot find it referred to in the Gangetic Fishes, we must therefore postpone naming it until we see the papers of the late Doctor, or the species itself.

#### IV. GEN.—COBITIS. LIN.

CHAR. Head and body elongated, little compressed, and no where depressed; the dorsal and ventral margins are little arched, and in some, almost straight; the snout is long and directed obliquely downwards, and projects slightly in front of a soft mouth, which is surrounded with short muscular cirri; three rays in the branchial membrane.

OBS. I sub-divide them into two sub-genera according to their general structure and the form of the caudal fin.\*

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\* Since the remarks were made in a preceding part of this paper on Mr. Gray's sub-division of the Loaches, I have been favoured with the perusal of a part of M. Agassiz's great work on Fossil Fishes, in which I perceive the spined Loaches are separated from the Linnæan genus as proposed by Mr. Gray. Surely a principle of division must be unnatural that would separate such species as *Cob. oculata*, t. 51. f. 1. and *Cob. pavonacea*, t. 52. f. 1.; and bring together such species as *Cob. dario*, Buch. P. G. t. 29. f. 95. and *Cob. cinnamomea*, t. 51. f. 5.—? : yet such would be the effect of adopting Mr. Gray's genus *Botia*, or what would be the same thing, M. Agassiz's genus *Acanthopsis* which differ only in name.

•  
 α SUB-GEN.—COBITIS PROPRIA.

CHAR. Caudal entire, large, and ornamented as well as the dorsal with bars or spots; prevailing colour of the body various shades of brown, disposed in more or less dense nebulae.

OBS. Air vessel small, oval, bony, and placed over the pharynx. The stomach is small and a little curved so as to bring its lower orifice in front of the organ when empty; in this state the intestine extends straight to the vent, but when the stomach is distended the intestine forms a few short serpentine turns. The first five apices have double suborbital spines on either side, except otherwise stated.

*Spec. C. oculata*, t. 51. f. 1. β

*C. gongota*, Buch. P. G. 351.

Orbits raised above the frontals, pupils small and vertical, pectorals and ventrals round, branchial membrane, large and attached behind to the base of the pectorals. D.11 : P.10 : V.7 : A.7 : C.16.

HAB. Assam, and the northern parts of Bengal.

*Spec. C. cucura*, Buch. t. 51. f. 2. β

Clouded with black along the lateral line, all the fins but the anal rounded. D. 9 : P.9 : V.6 : A.7 : C.15.

HAB. Northern parts of Bengal.

*Spec. C. guntea*, Buch. t. 51. f. 3. β

Two nebulous stripes on the sides, the lateral line copper colour. D.8 : P.8 : V.7 : A.7 : C.17.

HAB. Bengal and Assam.

*Spec. C. bimucronata*, t. 51. f. 4.  $\beta$

*C. botia*, Buch.

A single spine under each eye, body greenish above; below silvery, with a red tinge on the fins. D.14: P.13: V.8: A. 8: C.15.

HAB. North-eastern parts of Bengal.

*Spec. C. cinnamomea*, t. 51. f. 5.  $\beta$

*C. pangia*, Buch.

Very long and low, of cinnamon colour; dorsal opposite to the interval between the ventrals and anal. D.7: P.10: V.6: A.7: C.18.

HAB. North-eastern parts of Bengal.

The remaining species are without suborbital spines, and the dorsal is placed over the ventrals. They have each six cirri, and bars on the caudal and dorsal, which last is placed over the ventrals.

*Spec. C. ocellata*, t. 51. f. 6.  $\beta$

*C. bilturia*, Buch. P. G. Coll.

A small eye-like spot at the upper base of the caudal, and another at the hinder base of the dorsal; silvery, with clouded streaks. D.14: P.14: V.8: A.7: C.19.

HAB. Bramaputra.

*Spec. C. gibbosa*, t. 52. f. 7.  $\beta$

*C. turio*, Buch. P. G. Coll.

Back abruptly arched, a small ocellated spot on either side at the base of a square caudal. D.8: P.12: V.8: A.7: C.19.

HAB. Bramaputra.

*Spec. C. pavonacea*, J. M. t. 52. f. 1.

Body long, crossed by about twenty half bars, with an ocellated spot at the base of the caudal on either side. D.17: P.13: V.9: A.6: C.20.

HAB. Assam.

*Spec. C. monocera*, J. M. t. 52. f. 2.

Body without clouded or other marks, but the caudal and dorsal are ornamented with cross bars; a short blunt spine on the snout. D.12: P.12: V.8: A.6: C.18.

HAB. Assam.

*Spec. C. chlorosoma*, J. M. t. 52. f. 3.

Light green, clouded with a darker green, caudal and dorsal marked with spots in transverse rows. D.11: P.12: V.8: A.6: C.18.

HAB. Upper Assam.

The two remaining species have each only four cirri.

*Spec. C. guttata*, J. M. t. 52. f. 5. 6.

Colour light green, with dark blotches, eight rays in the dorsal.

HAB. Upper Assam.

*Spec. C. phoxocheila*,\* J. M. t. 52. f. 4.

Brown, caudal alone with bars, head much compressed, and raised obliquely as in the Perilamps. D.8: P.8: V.6: A.6: C.16.

HAB. Mishmee mountains. Griff. Coll.

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\* Φοξοχειλος, that has pointed lips.

## b. SUB-GEN.—SCHISTURA,\* J. M.

CHAR. Caudal bilobate, dorsal and ventrals opposite, anal short ; with or without suborbital spines ; sides ornamented with fasciated bars, mostly green.

OBS. The intestine is somewhat longer than that of the true Loaches (*Cobitis propria*), being usually reflected once upon the stomach.

The following species have each six cirri, and two suborbital spines on either side, except when stated to the contrary. The three first have a membranous natatory bladder placed in the abdomen, as in *Pæonominæ*, but its cells are separated by a longitudinal septum instead of a transverse stricture. Their form is arched and high as in ordinary Cyprins.

*Spec. C. dario*, Buch. P. G. t. 29. f. 95.

Seven transverse bars bifurcating and becoming faint below ; three or four interrupted bars on the caudal. D.11 : P.13 : V.8 : A.8 : C. $\frac{9}{10}$ .

HAB. Ganges and Bramaputra.

*Spec. C. geta*, Buch. P. G. t. 11. f. 96.

Seven transverse bars on the sides, one crossing the eyes, and one or two interrupted bars on the caudal.† D.12 : P.13 : V.8 : A.8 : C.19.

HAB. Bengal and Assam.

\* Etym. Σχιστος split or separated, and οὐρα cauda.

† I observed a slight difference in the form and number of the bars in some varieties of this species.



*Spec. Botia grandis*, Gray, Hardw. Illust. t. 94. f. 3.

Body olive-brown, with irregular yellow spots and streaks; eight cirri?

HAB. Said to have been found in the mountains of Kumaon; its description I believe is yet a desideratum; and as the only spotted species known, it might be named *S. maculata*.

The fins of the remaining species are without bars, spots, or other ornaments; the air vessel is bilobate, and placed over the pharynx, and the body is long and cylindric as in the true Loaches.

*Spec. C. balgara*, Buch. t. 53. f. 2. β

Clouded with brown above, below silvery. D.7 : P.7 : V.7 : C.17.

HAB. Northern frontier of Bengal.

*Spec. S. aculeata*, J. M.\*

Trenchant bony ridge between the eyes, clouded streaks on the sides. D.8 : P.9 : A.7 : C.—?

HAB. Assam.

*Spec. S. montana*, J. M. t. 57. f. 1. J. A. S. vol. vii. t. 55. f. 1.

Twelve zones encircling the body, with a black bar at the insertion of the caudal, and a single suborbital spine on each side. D.8 : P.10 : V.8 : A.6 : C.18.

HAB. Mountains at Simla. Dr. Macleod's Coll.

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\* This species corresponds in form with the preceding so closely that I have not figured it, and as I have not found Buchanan's species, I suspect they are the same; though he has not noticed the peculiarity of the head.

The following species are without suborbital spines, and have six cirri, except when the contrary is mentioned.

*Spec. C. scaturigina*,\* Buch. t. 53. f. 6.  $\beta$

Ventrals round, irregular cross bars on the sides, interrupted at the lateral line.

*Spec. S. subfusca*, J. M. t. 53. f. 5.

Ten regular brown zones encircling the body. D.11: P.11: V.7: A.7: C.17.

HAB. Assam.

*Spec. S. punctata*, t. 53. f. 4.

*C. corica*, Buch. P. G. Coll.

A row of spots on each side, and another along the back. D.9: P.11: V.7: A.6: C.19.

HAB. North-eastern parts of Bengal.

*Variet.* D.10: P.11: V.<sup>\*</sup>9: A.7: C.19.

HAB. Assam.

*Spec. S. zonata*, J. M. t. 53. f. 1.

Eleven dark green bars cross the body, with light green zones between them. D.11: P.11: V.8: A.6: C.17.

HAB. Assam.

*Spec. C. savona*, Buch. t. 53. f. 3.  $\beta$

Body compressed, dusky black above, with narrow yellow bars. D.10: P.10: V.6: A.6: C.—?

HAB. Northern parts of Bengal.

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\* This species is not referred to in the Gangetic Fishes, though figured in Buchanan's collection of drawings: to me it seems to be nearly allied to *S. subfusca*, but its fins appear larger.

*Spec. S. rupecula*, J. M. t. 57. f. 3. J. A. S. vol. vii. t. 55. f. 3.

About fourteen bars across the body, and three on the caudal ; pectorals and ventrals round. D.8 : P.10 : V.8 : A.7 : C.16.

HAB. Mountain streams at Simla. Dr. Macleod's Coll.

*Variet.* Thirteen rings round the body. D.9 : P.12 : V.8 : A.6 : C.17.

HAB. Stagnant pools in Upper Assam.

The more prominent characters only of each group and species being brought forward in the above classification, it is necessary in another part of the paper to enter more fully into particulars regarding the different species ; but the want of any museums or collections of fishes, public or private, in India, and the difficulty of preserving them in such a climate, are obstacles that have rendered the undertaking less complete than it ought to be. We may however hope, from the zeal evinced in different parts of India in favour of this untrodden branch of Natural History, that the subject will not be allowed to rest, until we have a perfect knowledge of all our fresh-water fishes, as well as of the particular family here but superficially noticed.



## DESCRIPTION OF PLATES.

## PLATE LIV.

- Fig. 1. Upper side of the right ramus of the lower jaw of *Cyprinus semiplotus*, J. M. Fig. 2, the same of *Cyprinus mrigala*, Buch. Fig. 3, the same of *Cyp. bata*, Buch. *a*, the point of union with its fellow at the symphysis; *b*, the articulating surface behind. Figs. 4, 5, 20, and 21, represent the lower side of the left ramus of the lower jaw in the Cirrhins; *b*, the articulating surface behind, and *a*, the point of approximation with its fellow in front, where instead of a symphysis the two bones are attached by ligaments. Fig. 6, the lower jaw of the Barbels, *c*, side view of the left limb of *Barbus hexastichus*, *d*, under side of the same; *a*, symphysis, *b*, articulating surface behind.
- Fig. 7. Side view of the scull of spined Loaches; *a*, suborbital spine erect; *b*, in its situation when concealed in the sinus. *d*, spine twice its natural size; *c*, its natural size.
- Figs. 8, 9, 10, and 11. General form and disposition of the stomach and intestines in *Pæonominæ*. Figs. 12, 13, 14, and 15, general form and disposition of the stomach and intestines in *Sarcoborinæ*; *a*, being the entrance to the stomach from the mouth, and *b*, the vent. Fig. 8, stomach and intestines of the Cirrhins. Fig. 9, stomach and intestine of the Barbels. Fig. 10, stomach and intestines of the Gudgeons. Fig. 11, stomach and intestines of the Gonorrhynchs.

Fig. 12. Stomach and intestine of the Systoms; fig. 13, of the Perilamps; fig. 14, of the Leuciscs; and fig. 15, of the Opsarions. In this last genus the alimentary canal is merely divided into stomach and cloaca.

Fig. 16. Stomach and intestine of *Platycara maculata*; fig. 17, stomach and intestine in the genus *Cobitis propria*; fig. 18, the same in *Schistura*.

Fig. 19. *Perilampus thermophilus*, J. M. The caudal fin in the only two specimens I received is imperfect.

#### PLATE XXXVII.

Fig. 1. *Catostomus dyocheilus*, J. M. Goreah of the Assamese; about one-fifth of the natural size.

Fig. 2. *Cyprinus semiplotus*, J. M. Senturee of the Assamese; with a figure of the head, natural size.

#### PLATE XXXVIII.

Fig. 1. *Cyp. mrigala*, Buch. One-fifth the natural size, from a living specimen in Assam. This is one of the species figured by Buchanan, *Pisc. Gang.* t. 6, 79, but there is such a want of character in the figure alluded to that I am induced to submit another, the accuracy of which may be put to the test in any of our fish markets in Bengal.

Fig. 2 β. *Cyp. cursa*, Buch. This figure is taken from Buchanan's Collection.

Fig. 3. *Cyp. cursis*, Buch. Drawn half size from a dried specimen. I afterwards found a far better figure of this species in Buchanan's collection. It is very nearly allied to *Cyp. cursa*, fig. 2;—both are distinguished by their small scales and the flesh being full of small bones. Fig. 4 is the air vessel, the anterior cell of which is double.

## PLATE XXXIX.

Fig. 1. *Oreinus guttatus*, J. M. Drawn the natural size of a specimen brought down from Boutan by Mr. Griffith. It belongs to the new sub-genus of Mountain Barbels; but the minute serrations on the hinder margin of the first ray of the dorsal fin are not shown in the figure, and the cross lines on the lower parts of the body are not natural, having been occasioned by keeping in spirits.

Fig. 2. *Barbus hexastichus*, J. M. An important species, inhabiting most of the large rivers in the north-eastern parts of Bengal. Its colours are probably subject to variation; but during the cold season all I met with in Assam were as represented in the drawing, which is about one-fifth of the natural size of the fish.

Fig. 3. *Barbus deliciosus*, J. M. Half the natural size.

Fig. 4. *Barbus spilophilus*, J. M. Half size from a specimen in spirits, found by Mr. Hodgson, and presented by him to the Asiatic Society; it is probably the *Cyp. chagunio* of Buch. The two long filaments in the anal are only, I suspect, an individual peculiarity.

## PLATE XL.

Fig. 1. *Gobio bicolor*, J. M. Natural size.

Fig. 2. *Gobio anisurus*, J. M. Natural size;—both are *Bangons* of the natives.

Fig. 3. *Cyp. curchius*, Buch. Half size; it is very nearly allied to Fig. 2, Pl. 38.

Fig. 4. *Oreinus progastus*, J. M. Half size. A characteristic, but not well executed figure of a species said to be poisonous; it is very common in the rapids of the Bramaputra, where it is called *Adoee* by the natives of the neighbouring parts of Assam, to whom it is well known.

## PLATE XLI.

Fig. 1. *Cirrhinus macronotus*, J. M. This is a large species, nearly allied to *Cyp. nandina*, Buch. P. G. t. 8. f. 84, and very common during the cold season in sandy streams in Assam, where it attains a great size and weight. It is a species that might be extensively propagated in ponds in all parts of India, and together with other herbivorous Cyprins might be rendered much more abundant by merely destroying the *Siluridæ* and Pikes, with which all the waters in the interior abound.

Fig. 2. *Cyp. rohita*, Buch. *Ruee* of the natives; no less celebrated in India than the Carp in Europe. It is the fish described by Buchanan, though not the one he has figured as the *Ruee*, the principal difference being in the form of the mouth. The various slight modifications of form under which the *Ruee* appears, prove the extent to which this species must have, at one period, been propagated in India. It is one of the largest and most abundant fishes in all parts of the country.

Fig. 3. *Barbus hexagonolepis*, J. M. *Bokar* of the Assamese; a large species very common. It is generally dark brownish on the back, bluish below, and on the opercula, and the scales and opercula are illuminated with yellow.

## PLATE XLII.

- Fig. 1.  $\beta$  *Cyp. pangusia*, Buch. Fig. 2. *Aplocheilus chrysostigmus*, J. M.  
Fig. 3. *Aplocheilus melastigmus*, J. M. Fig. 4.  $\beta$  *Cyp. pausio*, Buch.  
Fig. 5. *Leuciscus brachiatus*, J. M. Fig. 6.  $\beta$  *Cyp. joalius*, Buch.

## PLATE XLIII.—GONORHYNCHUS.

- Fig. 1. *Gonorhynchus gobioides*, J. M. Fig. 2.  $\beta$  *Cyp. lamta*, Buch. Fig. 3.  $\beta$   
*Gon. fimbriatus*, J. M. Figs. 4, 5. *Gon. rupeculus*. Fig. 6.  $\beta$  *Gon.*  
*gohama*, Buch. Fig. 7. *Gon. macrosomus*, J. M.

## PLATE XLIV.—SYSTEMUS.

- Fig. 1. *Systomus pyropterus*, J. M. Fig. 2.  $\beta$  *Syst. leptosomus*, J. M. Fig. 3.  
*Syst. tetrapugus*, J. M. Fig. 4.  $\beta$  *Cyp. gelius*, Buch. Fig. 5. *Syst.*  
*immaculatus*, J. M. Fig. 6.  $\beta$  *Cyp. canius*, Buch. Fig. 7.  $\beta$ . *Syst. gib-*  
*bosus*, J. M. Fig. 8.  $\beta$ . *Cyp. conchoni*, Buch. Fig. 9.  $\beta$  *Syst. mala-*  
*copterus*, J. M.

## PLATE XLV.—PERILAMPUS.

- Fig. 1.  $\beta$  *Perilampus reticulatus*, J. M. Fig. 2.  $\beta$  *Cyp. devario*, Buch. Fig. 3.  
*Peril. ostreographus*, J. M. Fig. 4.  $\beta$  *Peril. guttatus*, J. M.

## PLATE XLVI.—PERILAMPUS.

- Fig. 1.  $\beta$  *Perilampus striatus*, J. M. Fig. 2.  $\beta$  *Peril. recurvirostris*, J. M.  
Fig. 3.  $\beta$  *Cyp. sutiha*, Buch. Fig. 4. *Peril. psilopterus*, J. M. Fig. 5.  
*Peril. perseus*, J. M. Fig. 6.  $\beta$  *Peril. macropterus*, J. M.



## PLATE XLVII.—OPSARIUS.

Fig. 1. *Opsarius gracilis*, J. M. Fig. 2. *Ops. pholicephalus*, J. M. 2a, air vessel of this species reversed. Fig. 3. *Ops. leucerus*, J. M. Fig. 4. *Ops. maculosus*, J. M.

## PLATE XLVIII.—OPSARIUS.

Fig. 6. *Opsarius brachialis*, J. M. Fig. 7. *Ops. latipinnatus*, J. M. with its air vessel. Fig. 8.  $\beta$  *Ops. anisocheilus*, J. M. Fig. 9.  $\beta$  *Ops. fasciatus*, J. M. Fig. 10.  $\beta$  *Ops. albulus*, J. M. Fig. 5.  $\beta$  *Ops. megastomus*, J. M.

## PLATE XLIX.—PLATYCARA.

Fig. 1. *Balitora brucei*, Gray, Fig. 2. *Platycara maculata*, J. M. Both these figures are taken from Hardwicke's Illustrations, in consequence of the important light their singular forms cast upon the affinities of the whole family.

## PLATE L.—PSILORHYNCHUS.

Fig. 1.  $\beta$  *Psilorhynchus sucatio*, J. M. The figure of this remarkable species is from Buchanan's collection.

Fig. 2.  $\beta$  *Psilorhynchus variegatus*, J. M. Also from Buchanan's collection. I have never met with either of these species.\*

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\* Since this and other remarks on the same subject (page 248) were written, I have been favoured with a small collection of fishes from Captain Hormay of Upper Assam, in which I find one specimen of *Psil. variegatus*, a description of which will appear in a subsequent part of this paper.

## PLATE LI.—COBITIS.

Fig. 1.  $\beta$  *Cobitis oculata*, J. M. Fig. 2.  $\beta$  *Cob. cucura*, Buch. Fig. 3.  $\beta$  *Cob. guntea*, Buch. Fig. 4.  $\beta$  *Cob. bimucronata*, J. M. Fig. 5. *Cob. cinnamomea*, J. M. Fig. 6.  $\beta$  *Cob. ocellata*, J. M. All these figures are from Buchanan's collection of unpublished drawings; the first, third, fourth, and sixth species are in my collection also, but as Buchanan's figures are better than mine, I give them the preference.

## PLATE LII.—COBITIS.

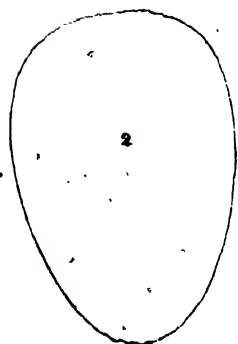
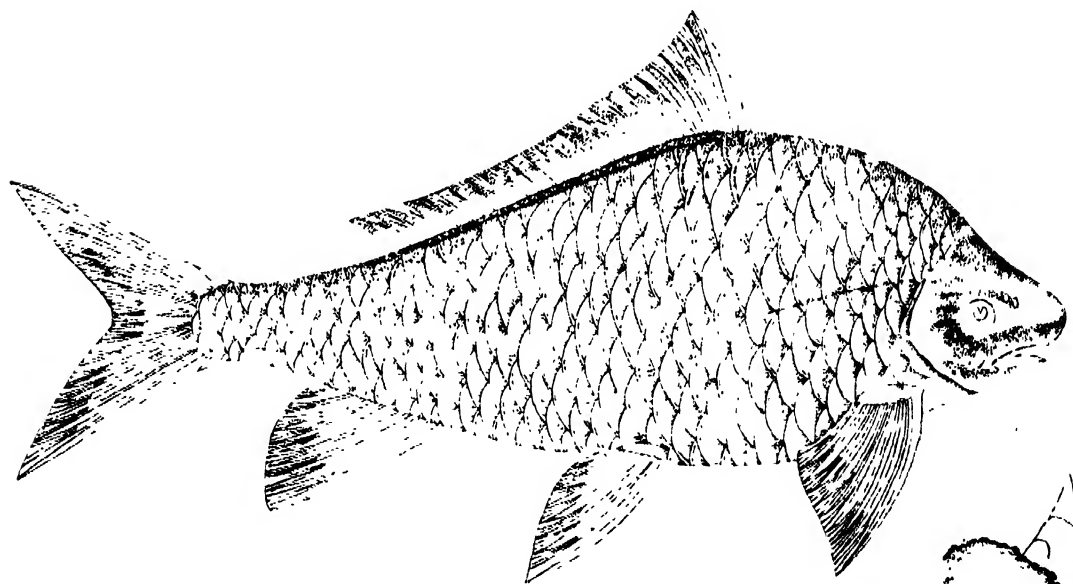
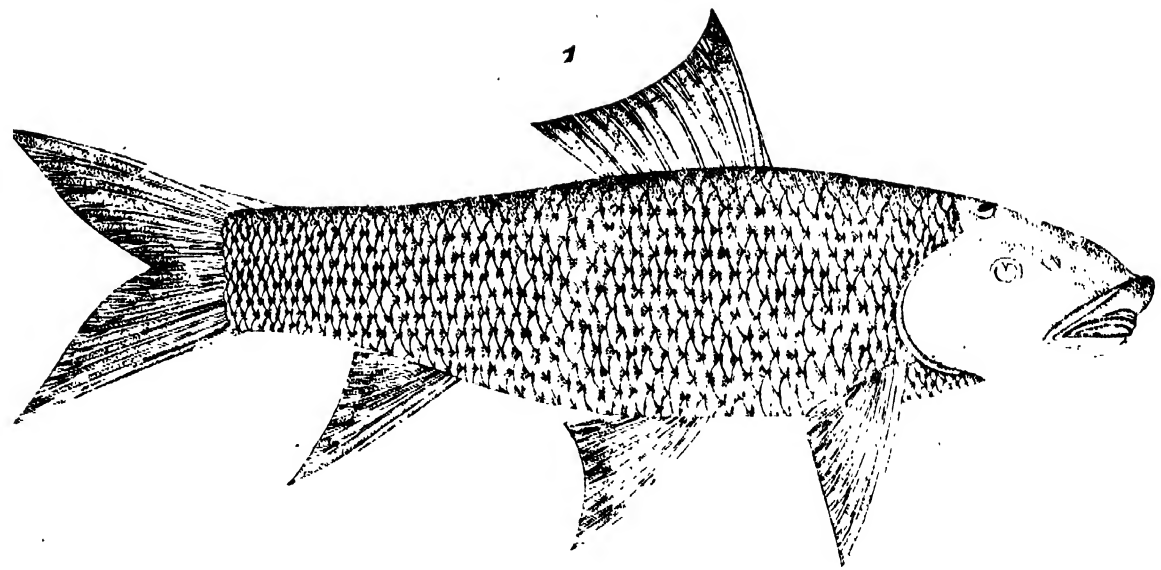
Fig. 1. *Cobitis pavonacea*, J. M. Fig. 2. *Cob. monocera*, J. M. Fig. 3. *Cob. chlorosoma*, J. M. Fig. 4. *Cob. phoxocheila*, J. M. Fig. 5. *Cob. guttata*, J. M. fig. 6. head of the same magnified, showing the cirri to be four, on which its specific character rests. Fig. 7.  $\beta$  *Cob. gibbosus*, J. M.

## PLATE LIII.—SCHISTURA.

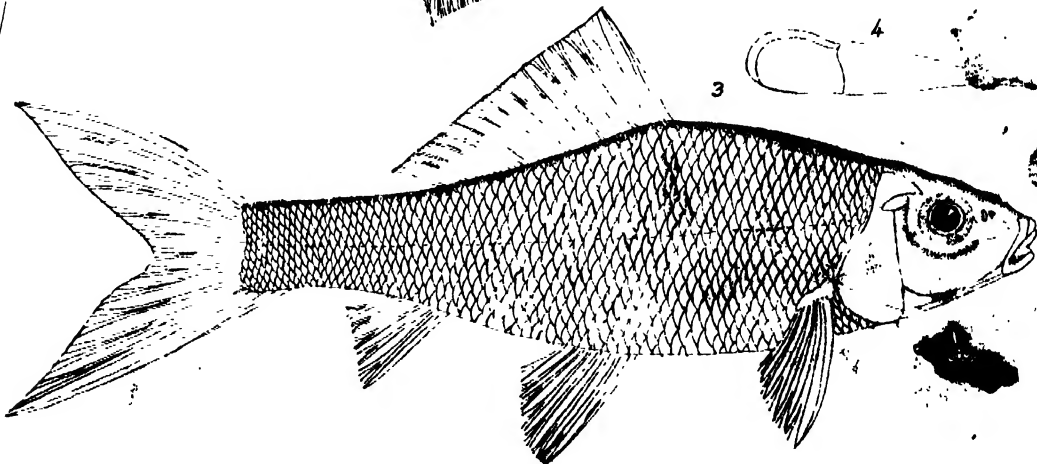
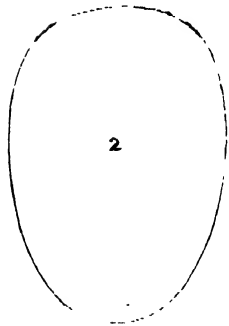
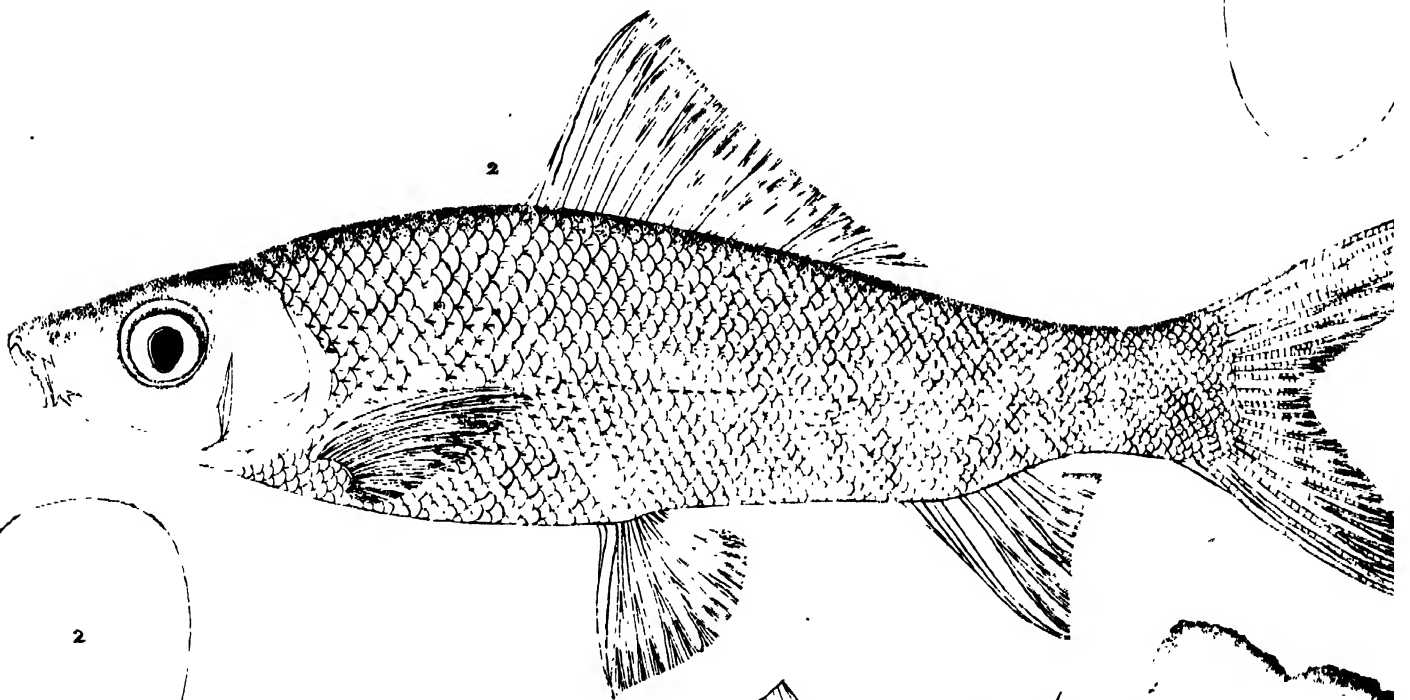
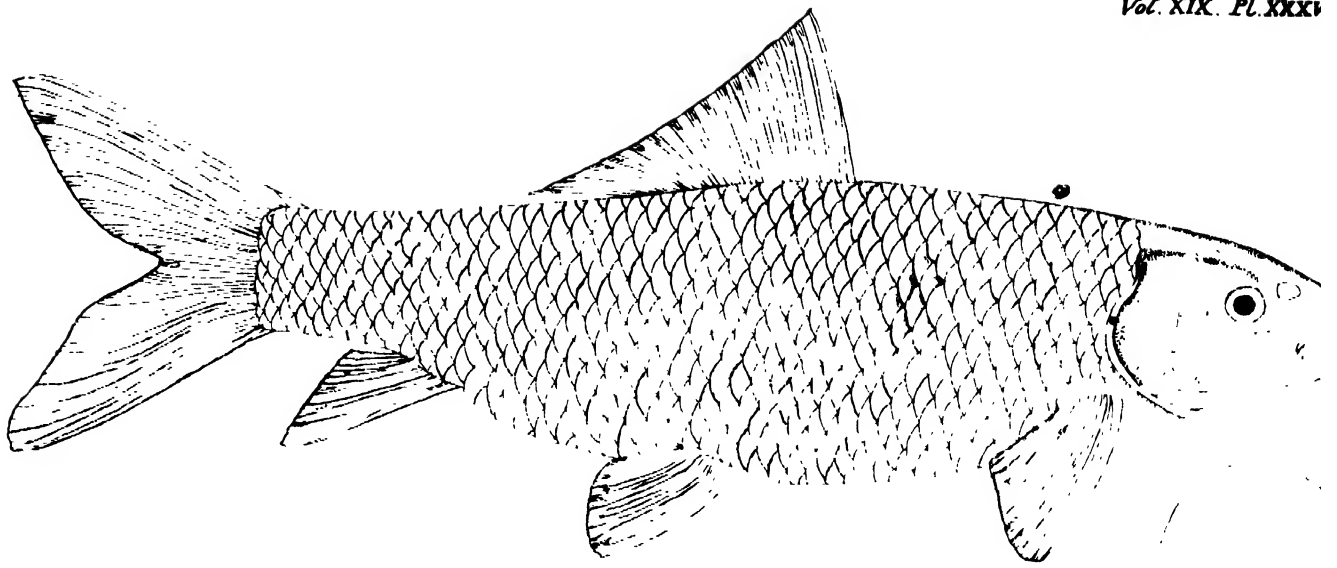
Fig. 1. *Schistura zonata*, J. M. Fig. 2.  $\beta$  *Cob. balgara*, Buch. Fig. 3.  $\beta$  *Cob. savona*, Buch. Fig. 4.  $\beta$  *Schist. punctata*, Fig. 5. *Schist. subfusca*, J. M. Fig. 6.  $\beta$  *Cobitis scaturigina*, Buch.

## PLATE LV.

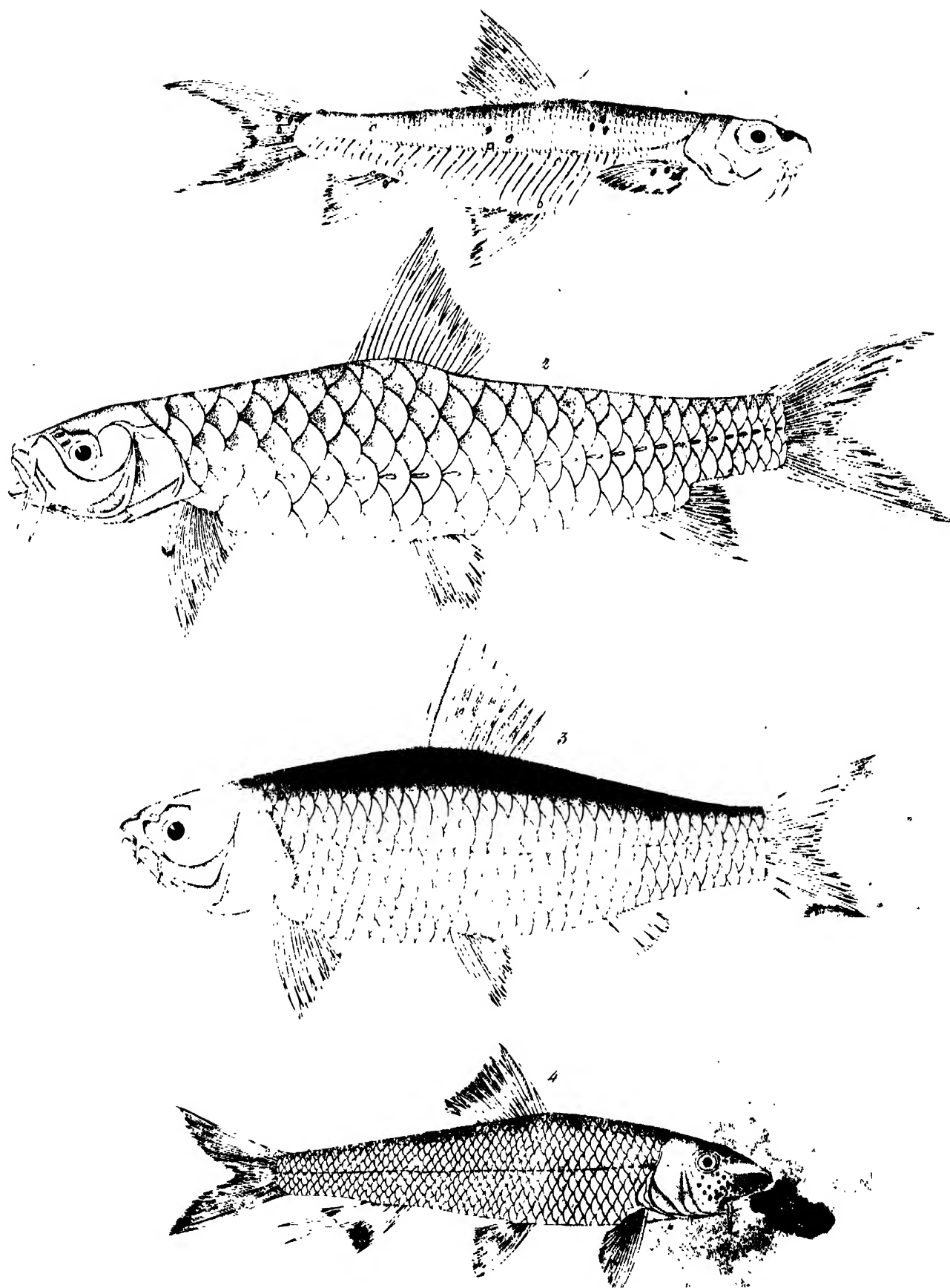
Fig. 1. *Gobio ricnorhynchus*, J. M. Fig. 2. *Barbus macrocephalus*, J. M. Fig. 3. *Gob. limnophilus*, J. M. Fig. 4, is a species of the curious genus *Aplocheilus* figured in Buchanan's collection, but not named on the drawing, or alluded to in the Gangetic Fishes; nor has the species itself been met with by me. It differs apparently from the two I have described, in the greater depth of the body, as well as in other characters, which, however, it would be unsafe to derive from the figure alone. Fig. 5. *Gobio lissorhynchus*, J. M.





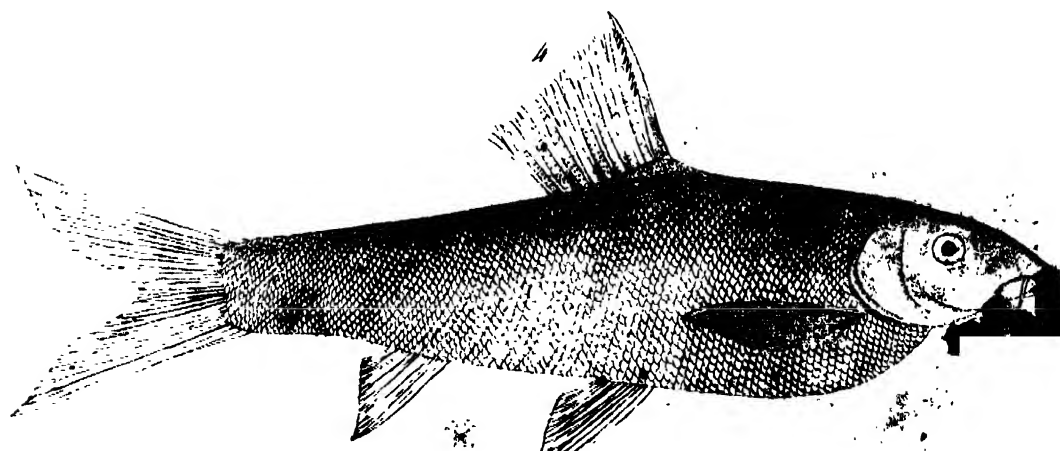
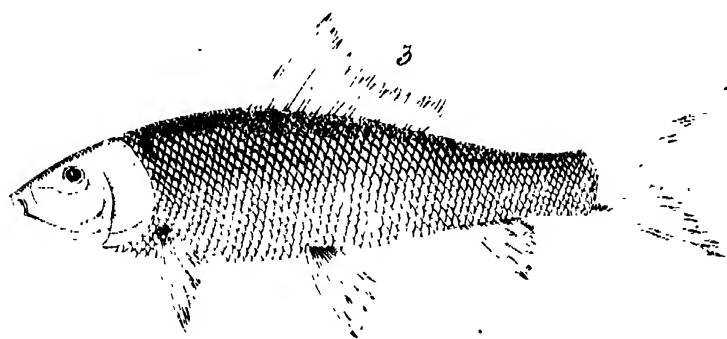
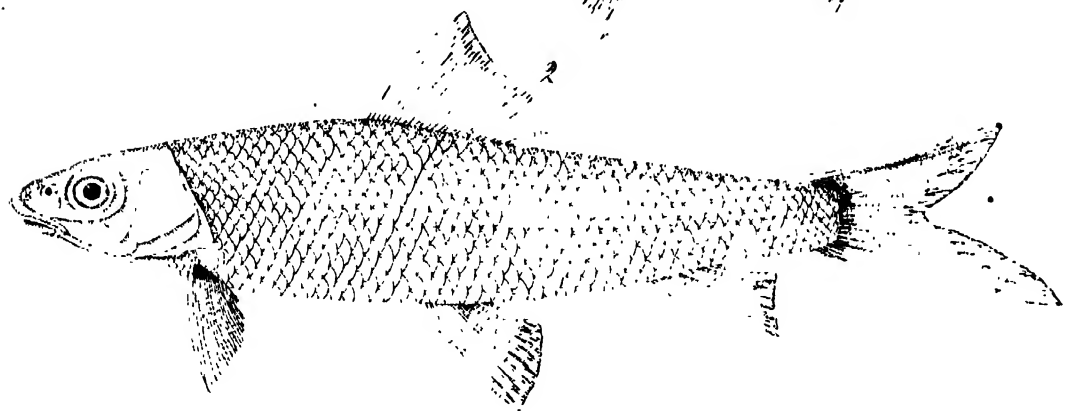
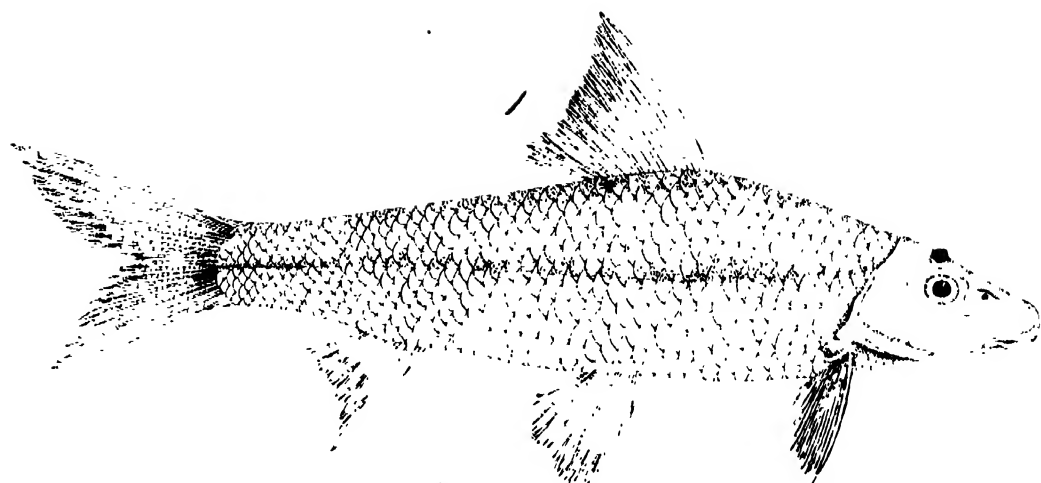




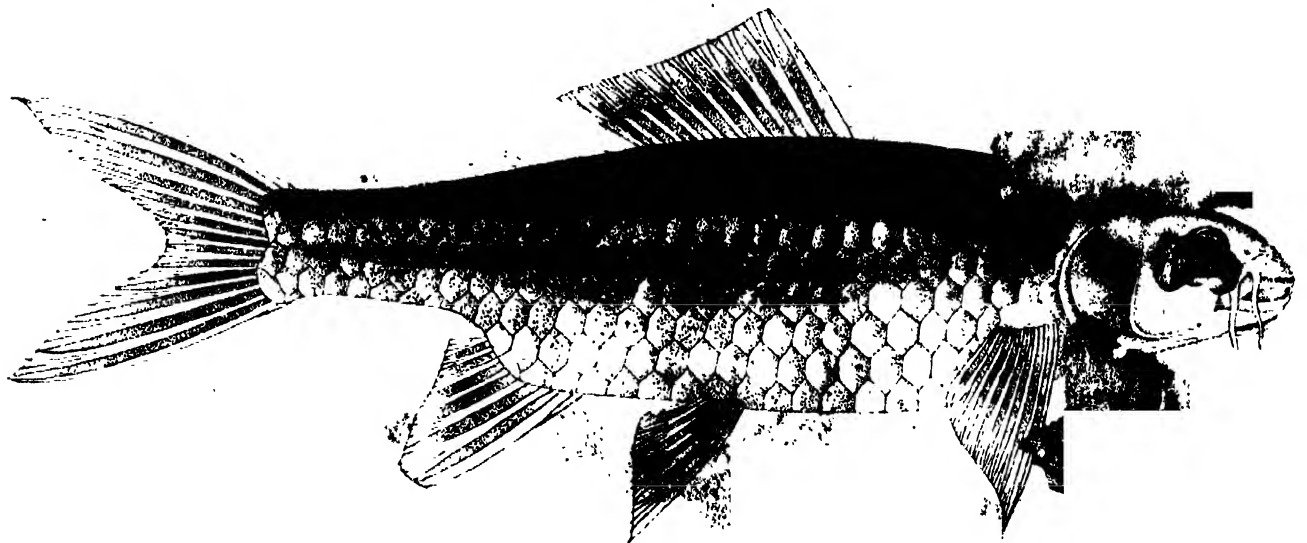
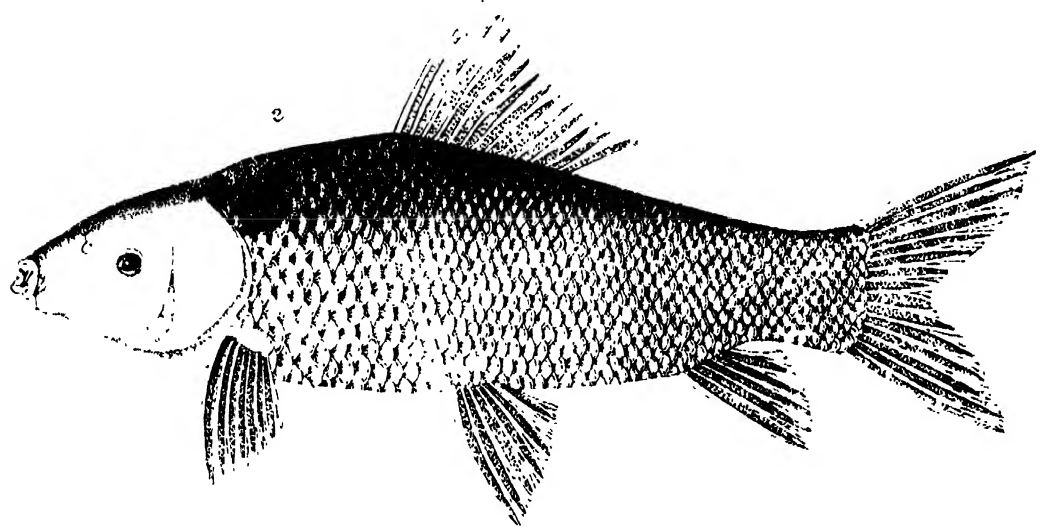
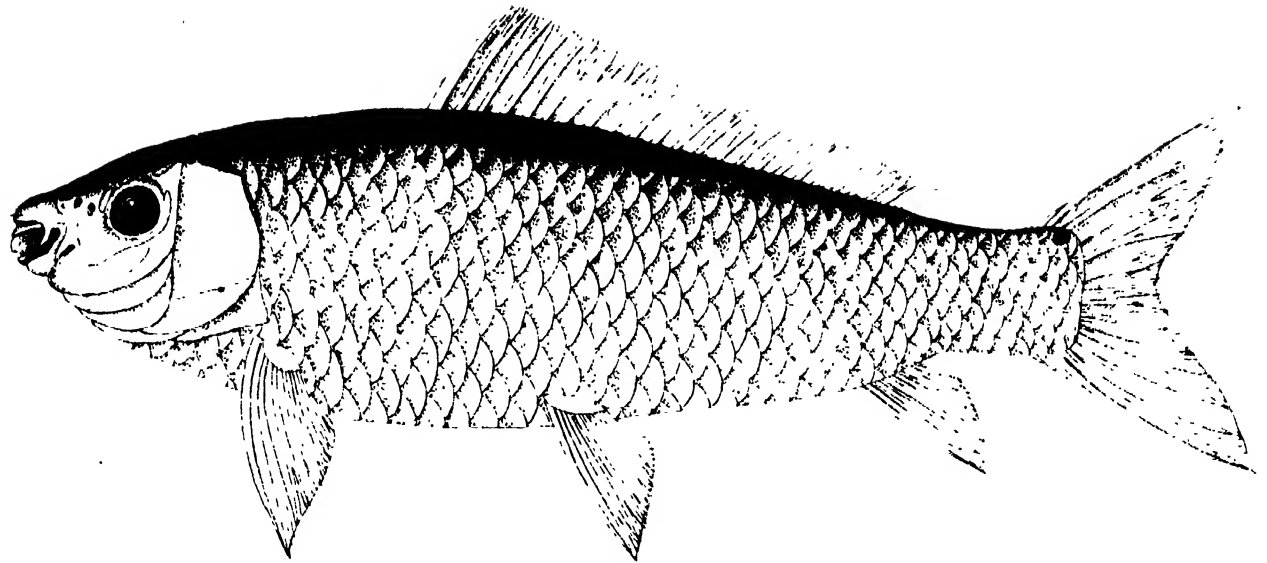




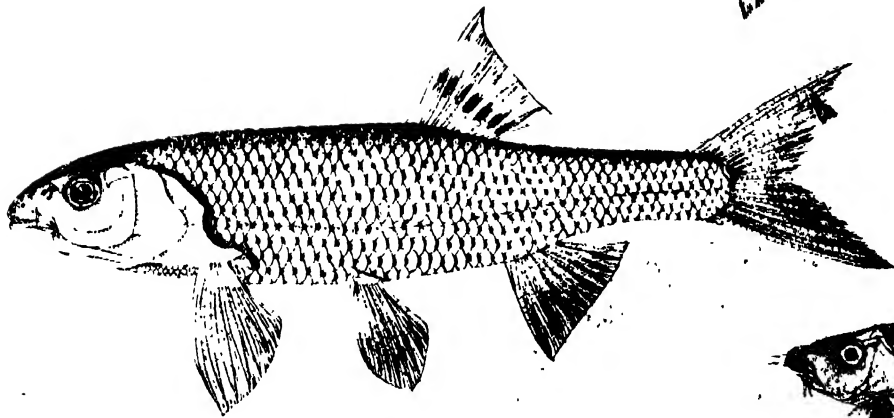
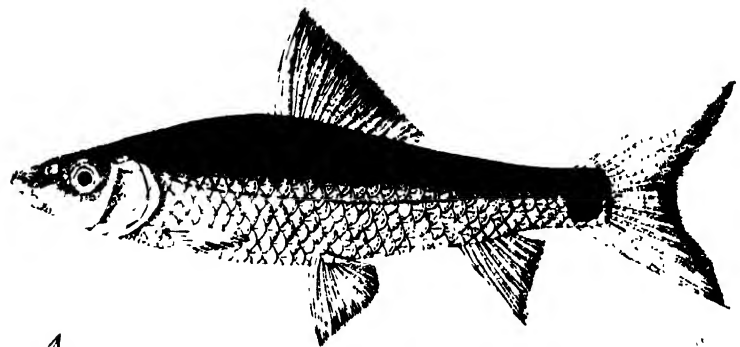
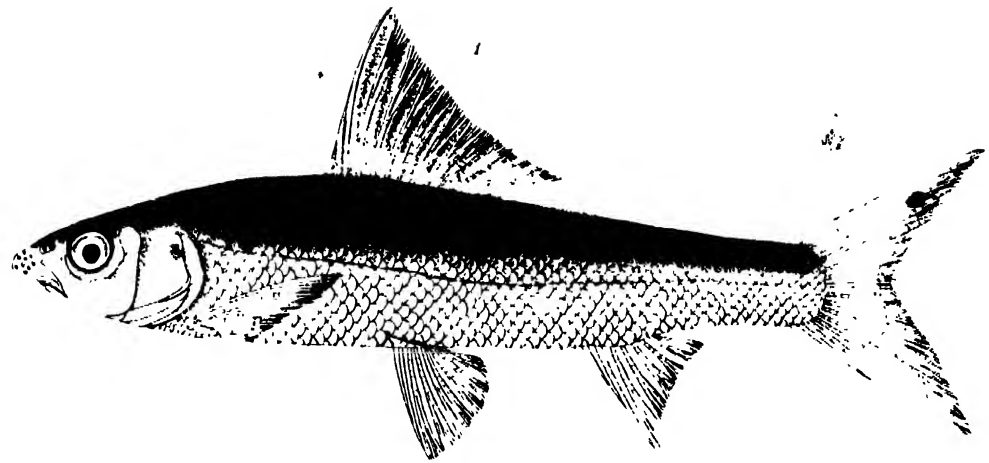




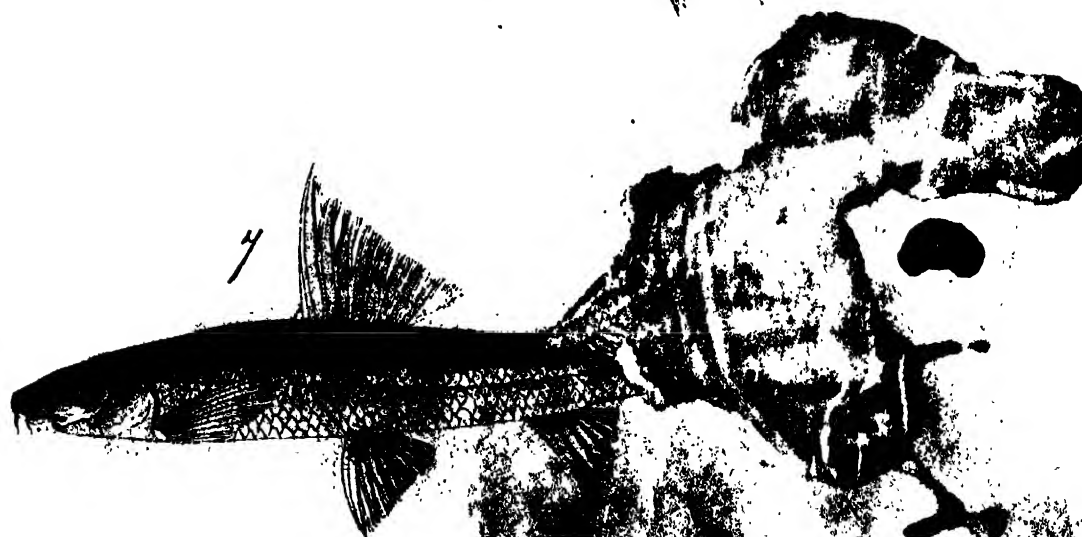
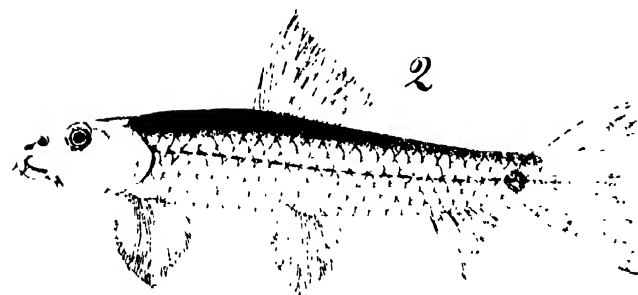
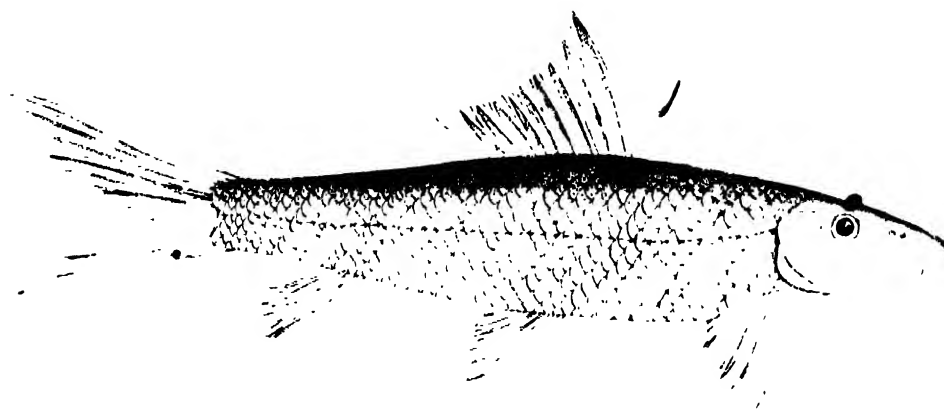






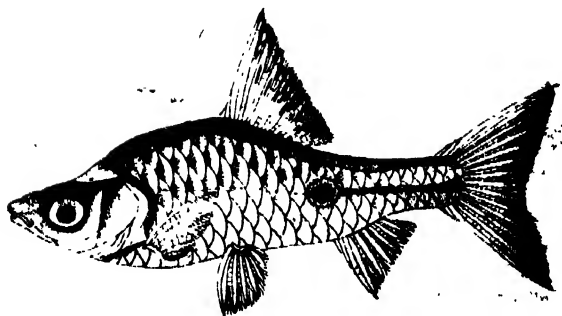
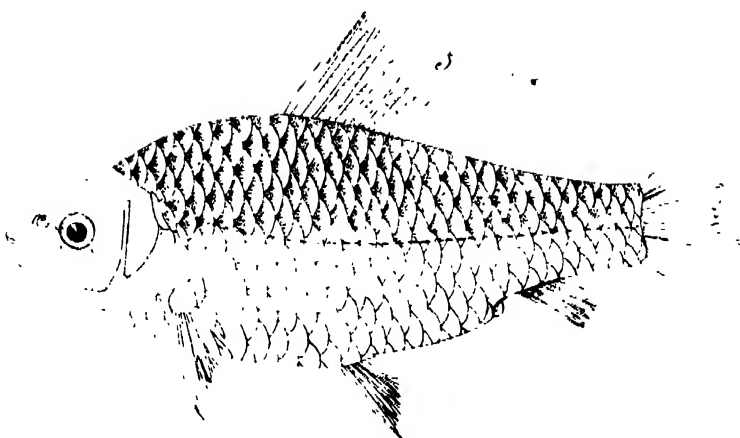
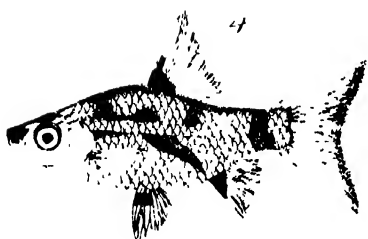
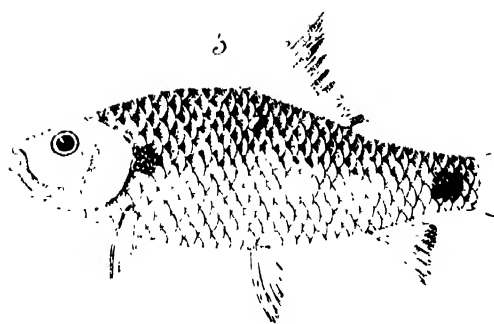
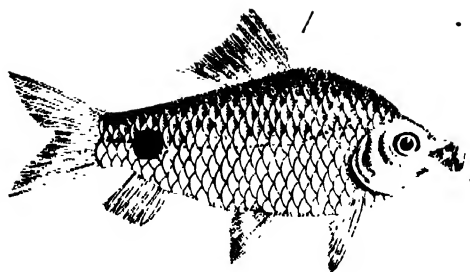




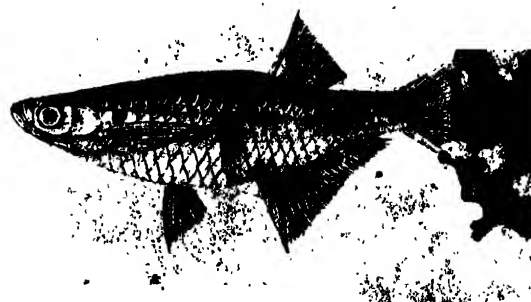
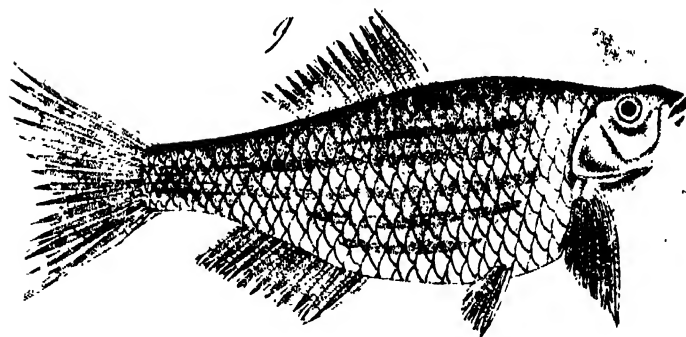
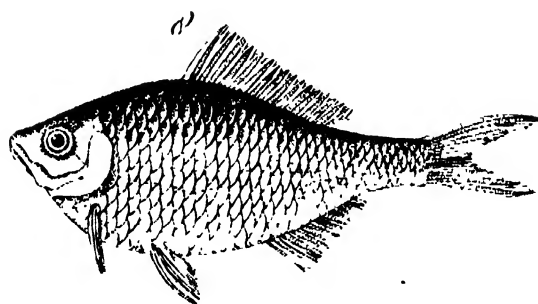
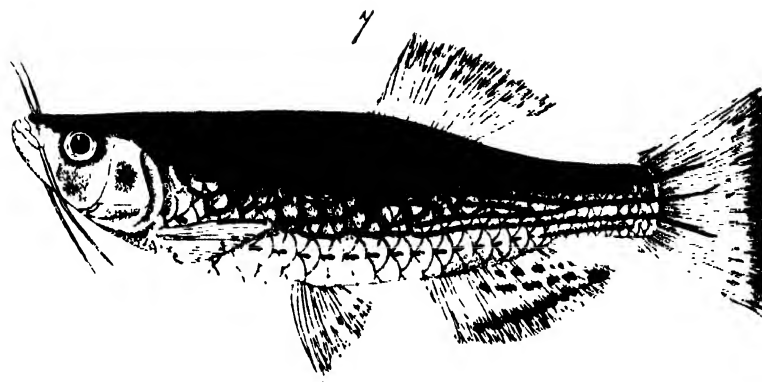




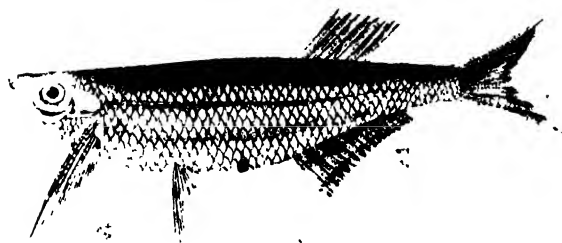
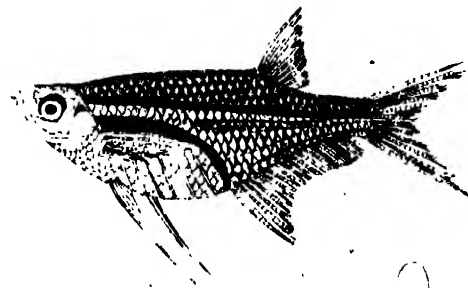
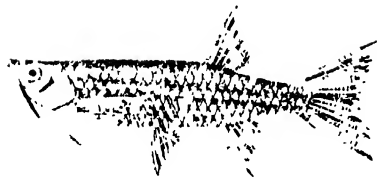




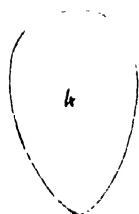
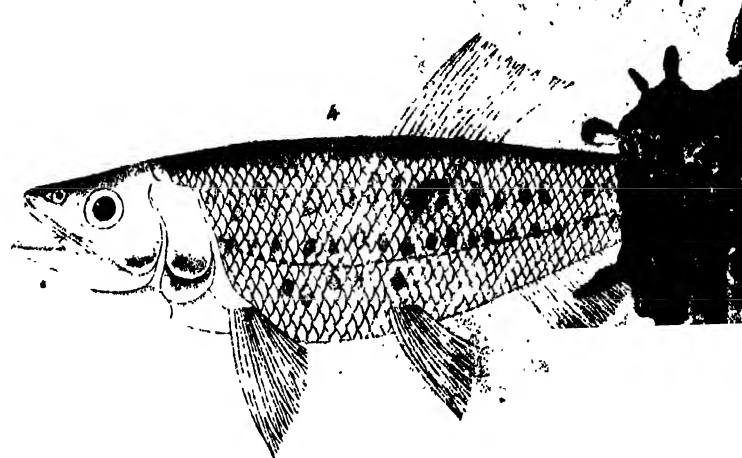
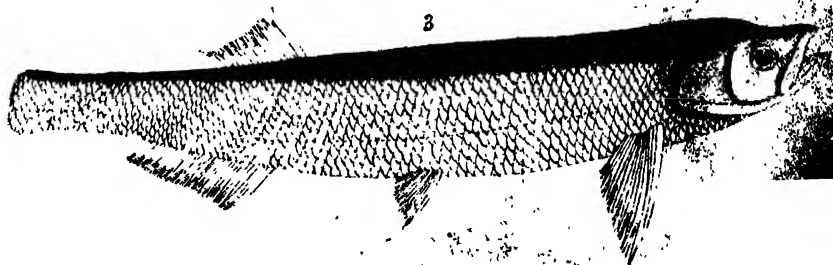
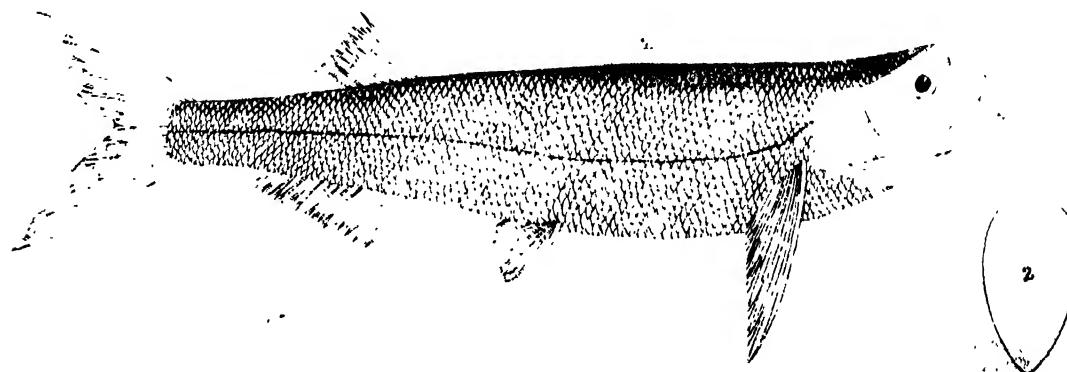
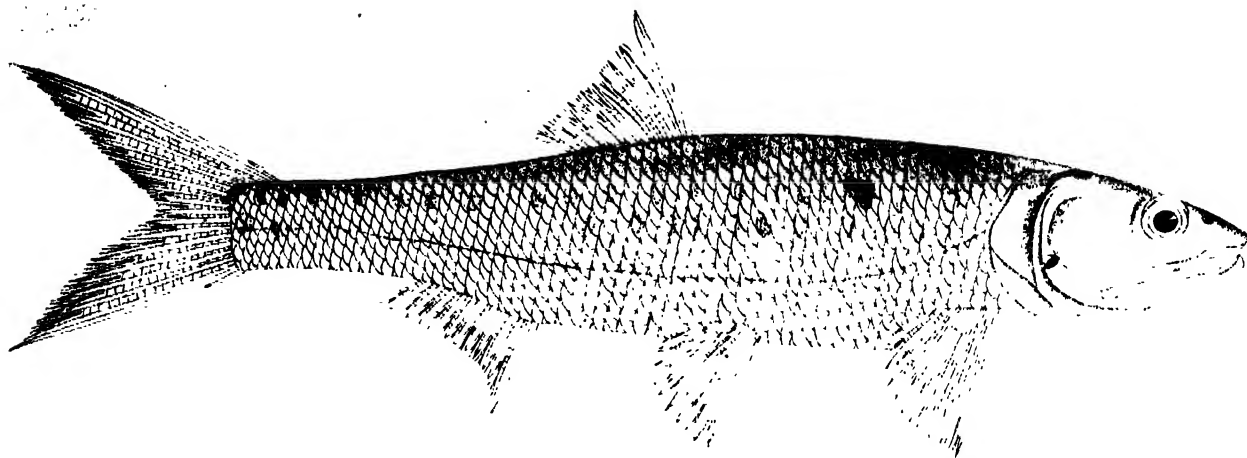






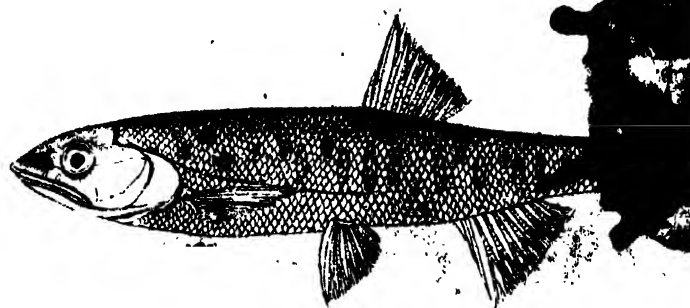
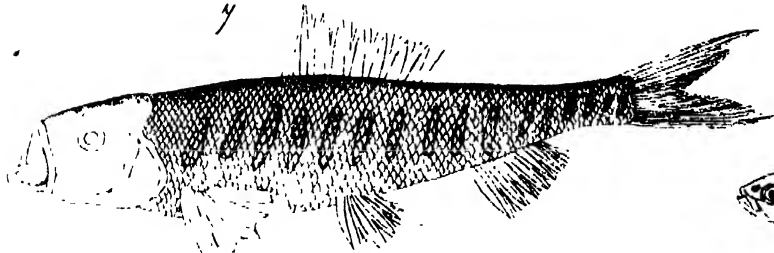
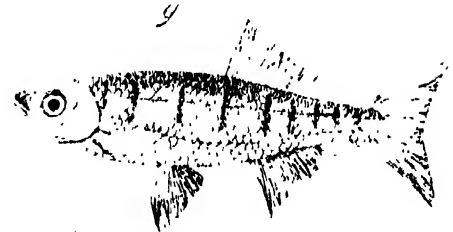
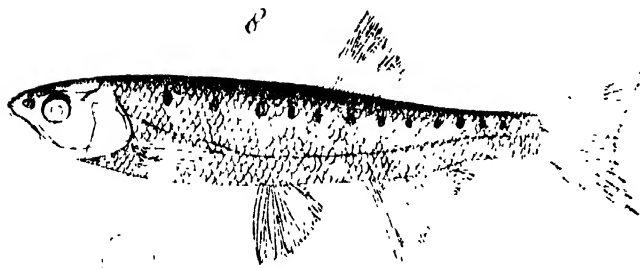
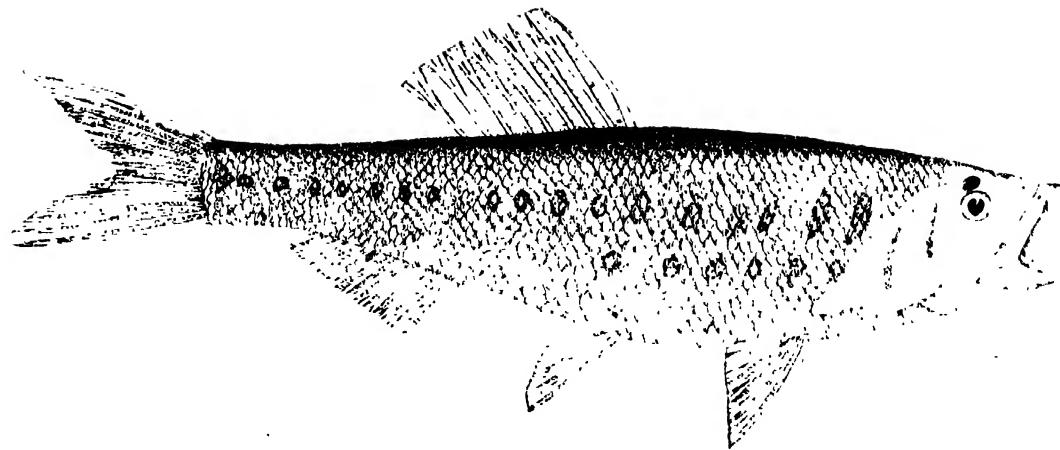




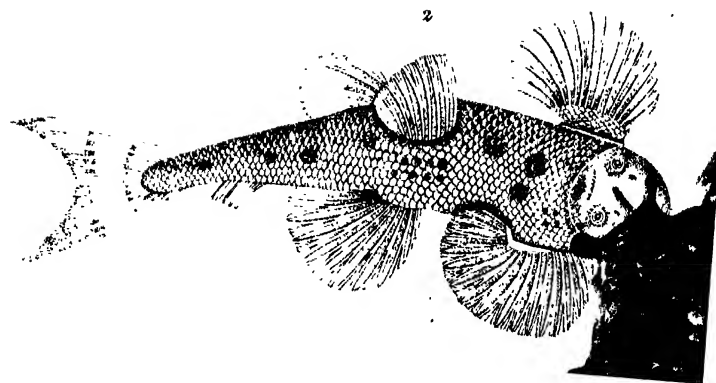
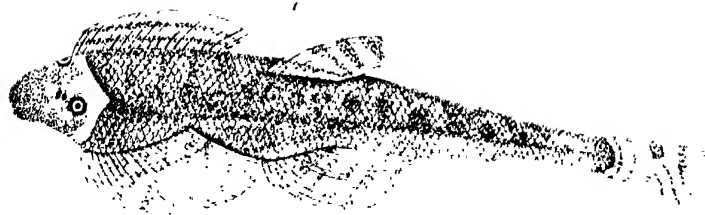




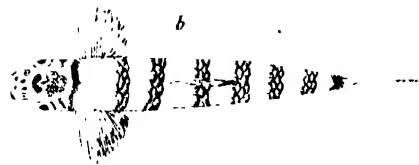
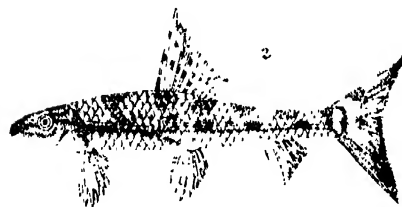
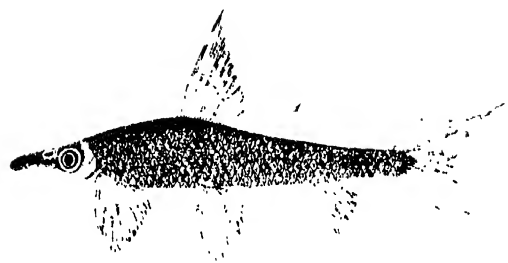
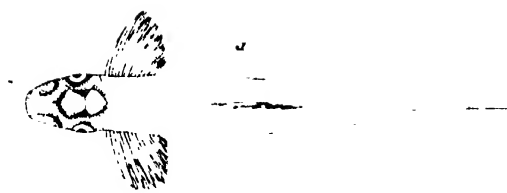




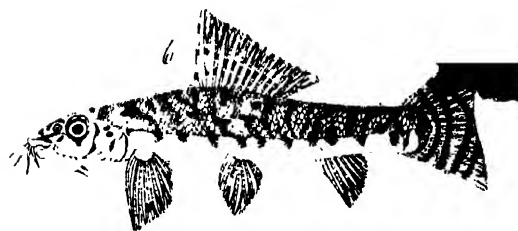
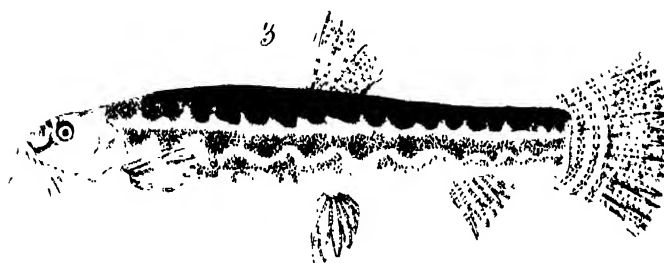
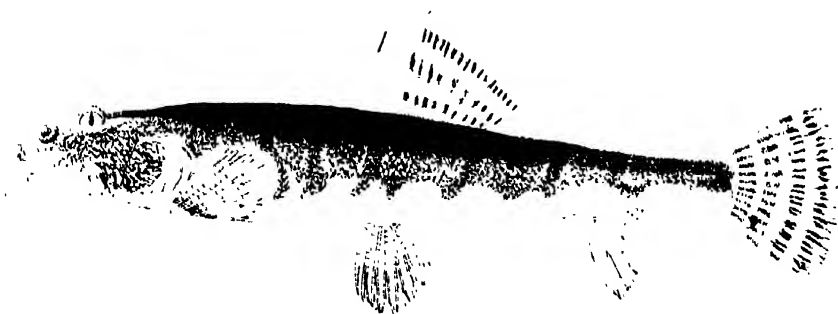






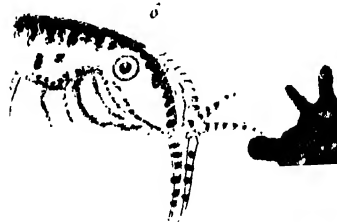
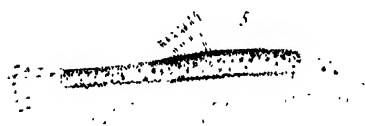
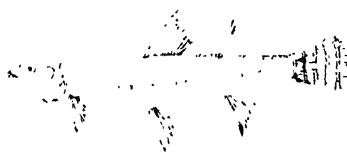
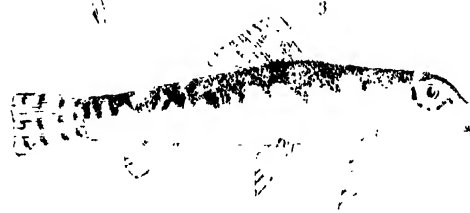




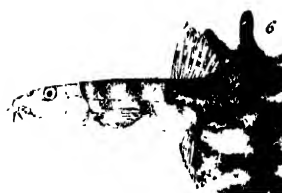
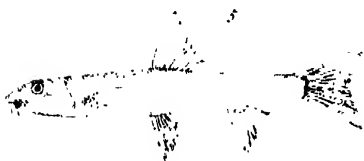
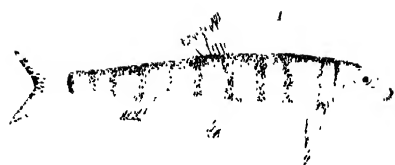




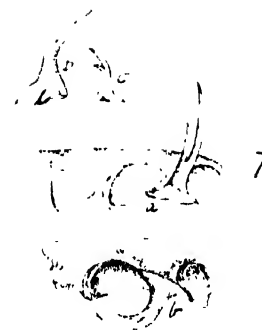
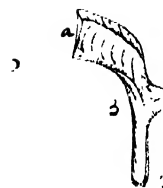
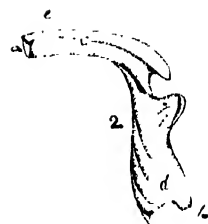
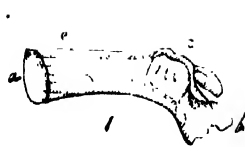




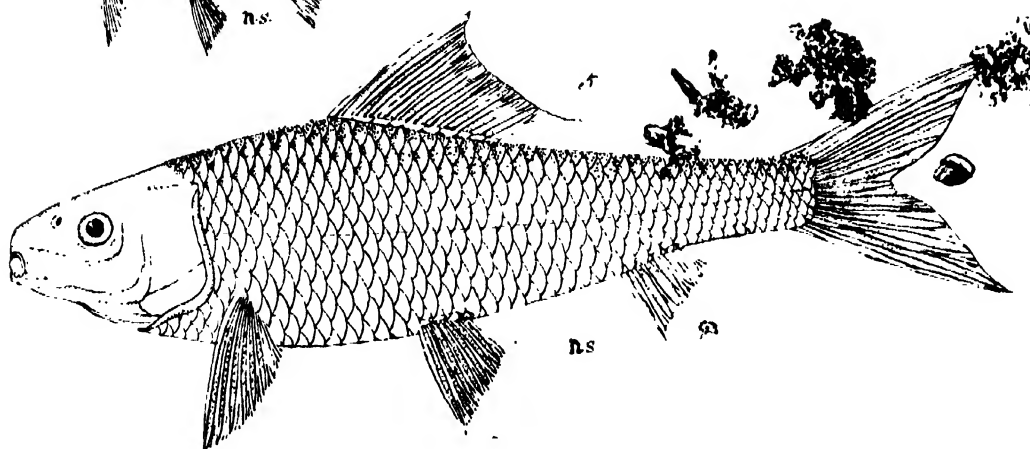
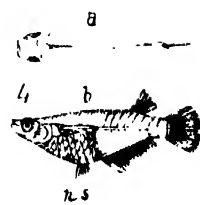
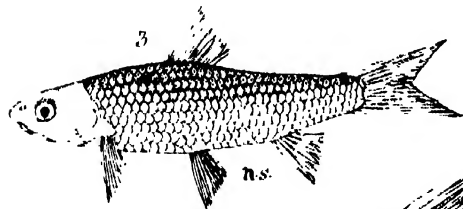
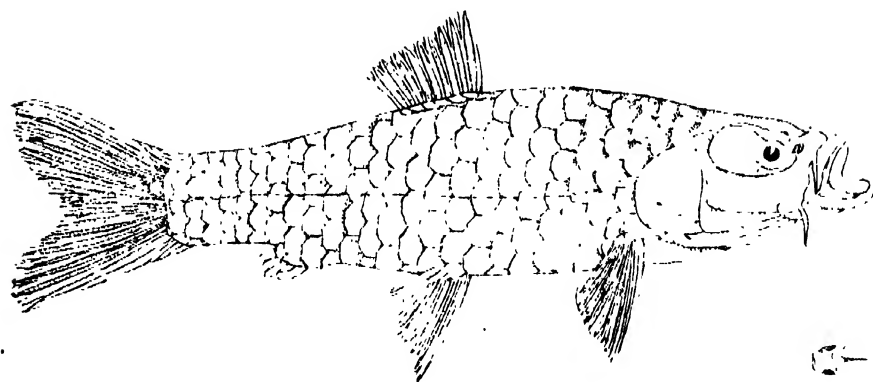
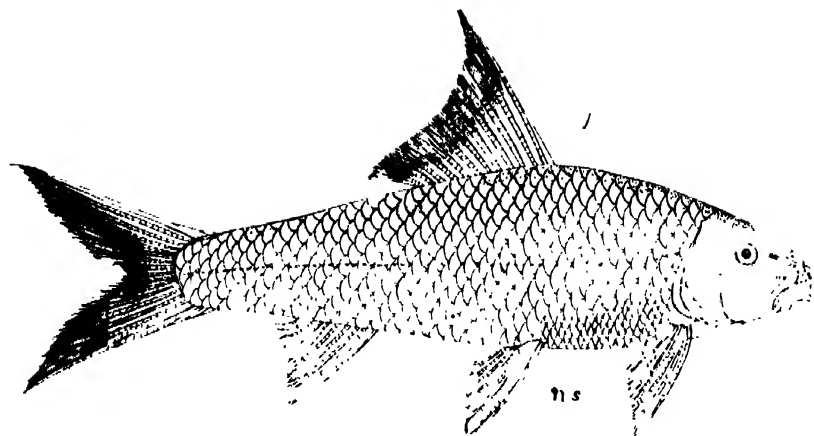






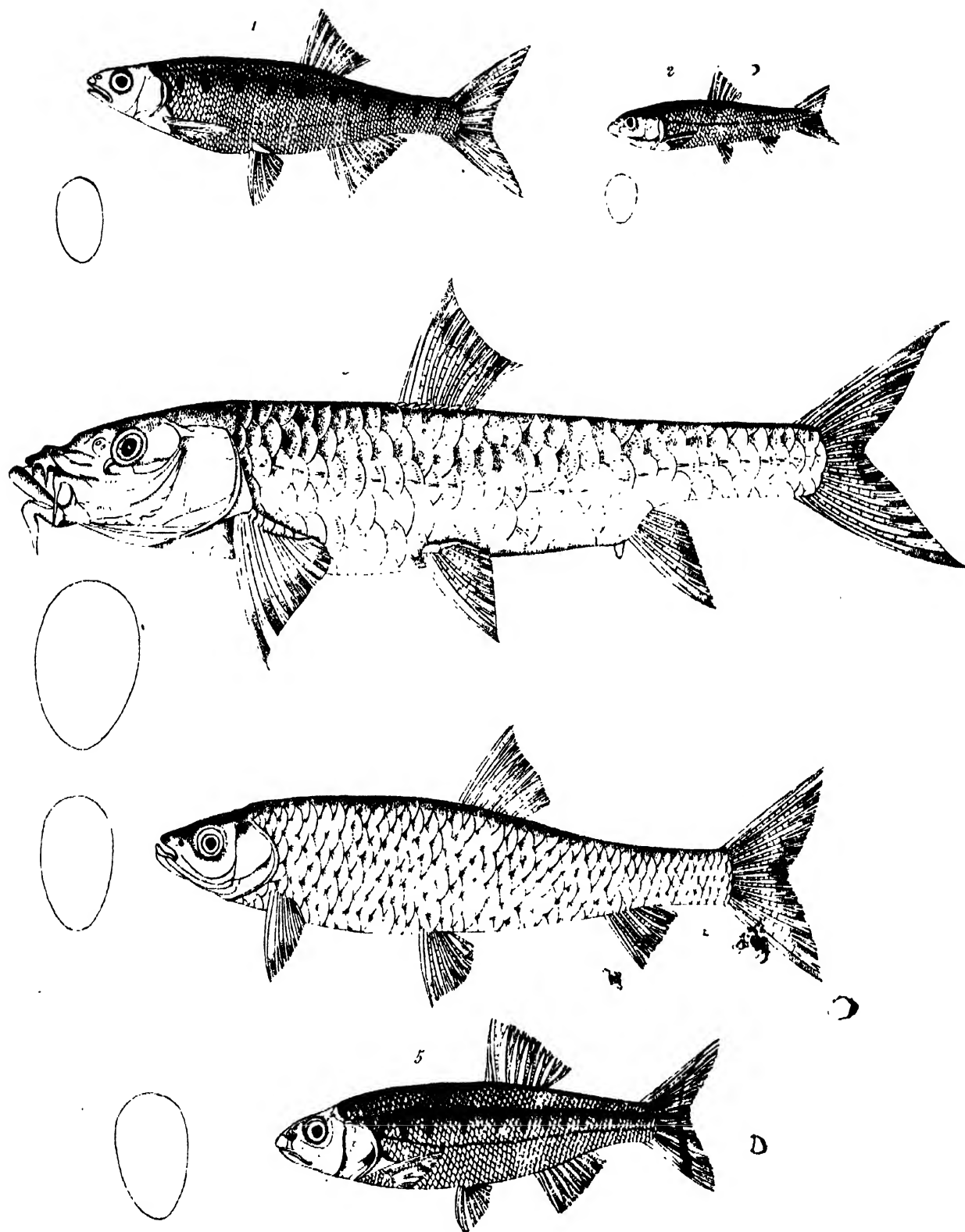




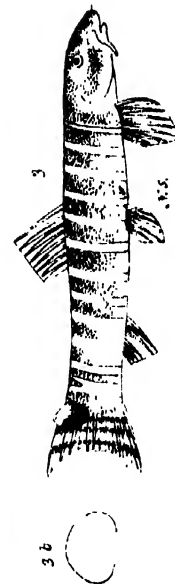
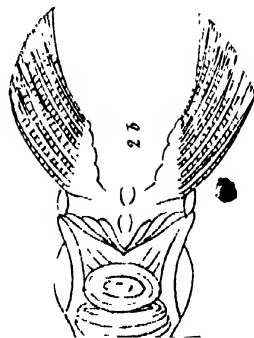
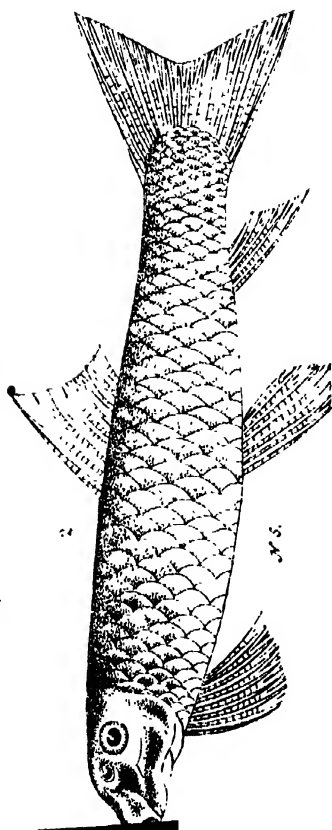
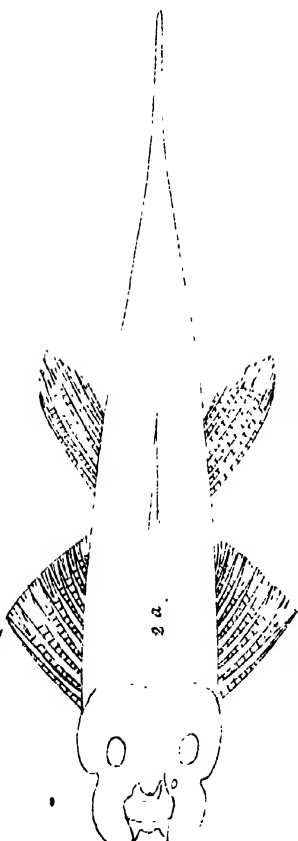
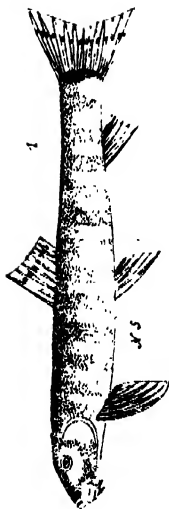
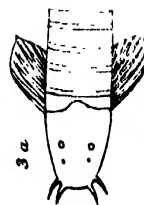
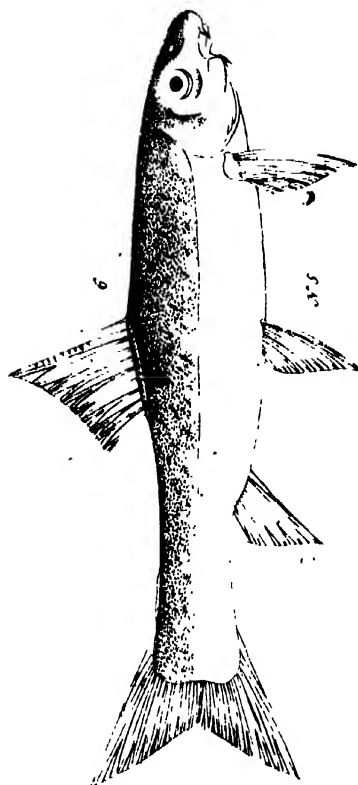
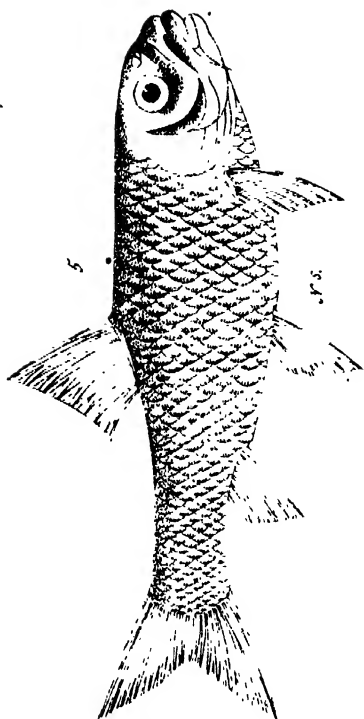
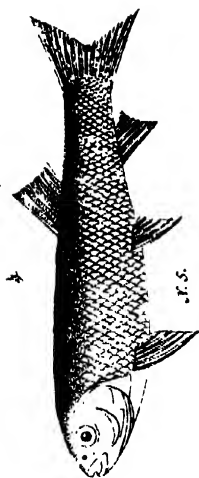




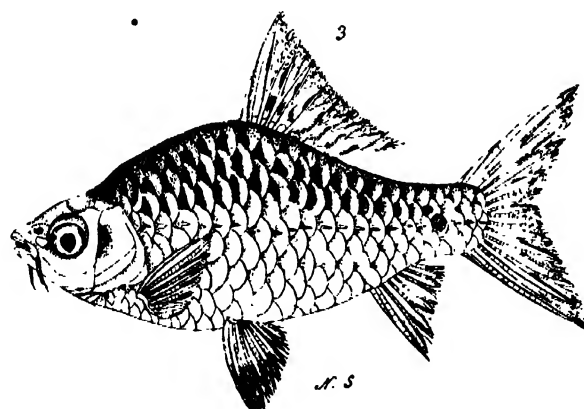
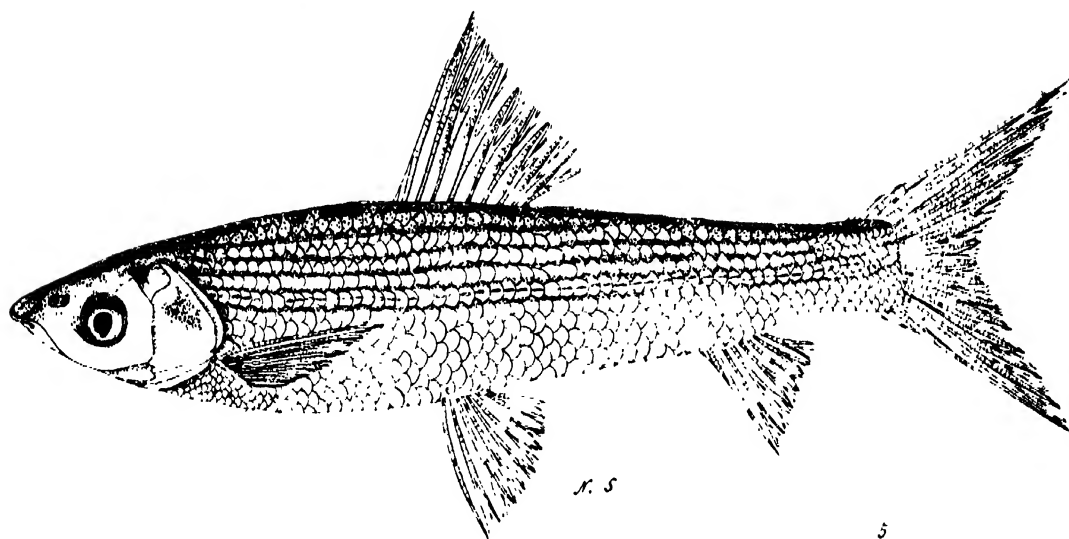
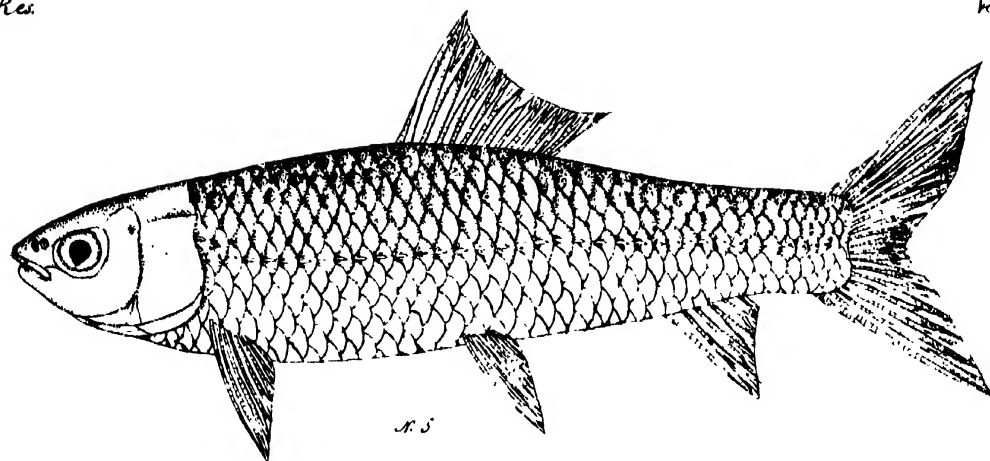














## PLATE LVI.

- Fig. 1.  $\beta$  *Opsarius isocheilus*, J. M. Fig. 2.  $\beta$  *Lenciscus margarodes*, J. M.  
Fig. 3. *Barbus progeineus*, J. M. Fig. 4. *Leusciscus dystomus*, J. M.  
natural size. Fig. 5.  $\beta$  *Opsarius cirratus*, J. M.

## PLATE LVII.

- Fig. 1. *Schistura montana*, J. M. Fig. 2. *a, b, Platycara nasuta*, J. M.  
Fig. 3. *3 a, Schistura rupecula*, J. M. Fig. 4. *Leuciscus elingulatus*,  
J. M. Fig. 5. *Barbus cheilynoides*, J. M. Fig. 6. *Oreinus macu-*  
*latus*, J. M.

## PLATE LVIII.

- Fig. 1. *Cyprinus mrigala*, Buch., or that variety called *Rewah* by the Ben-  
galese. Fig. 2.  $\beta$  *Cyp. bangon*, Buch. Fig. 3.  $\beta$  *Cyprinus chola*,  
Buch. Fig. 4, the air vessel as it occurs in the smaller species of  
*Schisturæ*. Fig. 5, as it occurs in *Cobitis propria*, J. M.

The remaining plates, chiefly representing the structure of the scales of  
nearly allied species, will be afterwards described.

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ACCOUNT OF SPECIES.

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## CIRRHINUS MACRONOTUS, J. M.

t. 41, f. 1.

This is a large wholesome fish, much resembling the European Carp, but without the dorsal spine of that species. It is very nearly allied to Buchanan's *Cyp. nandina*, but has three rays less in the dorsal fin, and other slight peculiarities, which may however be mere variations arising from artificial propagation, or other causes.

The length of the head to that of the body, exclusive of the head and caudal fin, is as one to four, and the greatest depth is equal to one-third of the length. The dorsal fin commences at the most prominent part of the back, at a distance from the head equal to about a third length of the body, and extends to within half such distance from the caudal.

The ventrals are placed in the middle of the body, somewhat behind the commencement of the dorsal and the anal, on the posterior third of the space between the ventrals and the insertion of the caudal. The base of the dorsal fin is equal to nearly twice the length of the head; the first of its rays is scarcely half the length of the second, but all the rays are comparatively short, and the membrane of the fin thick and strong. The fin rays are,

D.23 : P.16 : V.9 : A.7 : C.19.

There are forty-one scales along the lateral line, and thirteen in an oblique row from the base of the ventrals to the back. The head is larger in every respect than that of *C. calbasu*, Buch., but shorter and blunter, as well as more bulky, than that of *C. rohita*, Buch. The posterior margin of the operculum is the segment of a circle whose centre is situated on the lower and posterior



corner of the orbit; the mouth is similar to that of *C. rohita*, except that it is a little smaller, and the two bony limbs of the lower jaw stronger, and their transverse apophyses more massive. See t. 54, f. 5.

Buchanan observed that a variety of *Cyp. nandina* occurs with twenty-three rays in the dorsal instead of twenty-six. The variety alluded to is no doubt the one here described; affinities run so close between several of the larger species of *Cirrhins* that it is only by comparison of many individuals, that we can arrive at satisfactory specific distinctions. This species was observed by Buchanan in the Goruckpur district, on the northern frontier of Bengal; the individuals I met with in Assam, in March, were found in sandy streams which they had entered probably for the purpose of spawning. They are seldom seen so high in the Bramaputra as the rapids, and never, I believe, so low as to come within the influence of the tides, which effect a change by the deposit of mud instead of sand, no less remarkable in the bottoms and banks of rivers, than in the character of the fresh water fishes which are found within their influence.

## II.—CYPRINUS NANDINA, Buch.

Pisc. Gang. t. viii. f. 84. *Nandin* of the fishermen.

Length of the head compared to that of the body as one to three, forty-four scales along the lateral line, and twelve in an oblique line from the base of the ventrals to the dorsum, which is much arched. The dorsal commences on the most prominent part of the back, at a distance from the head, equal to the length of that organ. The fin rays are,

D.26 : P.16 : V.9 : A.7 : C.19.

The specimen from which this description is formed, was found by Mr. Griffith in the great jeels on the northern side of Bengal. I think I have met with it in the Bramaputra as high as Gowahattee, but it disappears where the currents become rapid, and the water more cool and clear. Buchanan found it very abundantly in the marshes adjacent to the ruins of the ancient

Gour, on the northern side of Bengal, where it usually attains two or three feet in length, and is a well flavoured and wholesome food. Its form, he says, is thick, but still slightly compressed, and the colour of the upper part of the body is dark green, with a coppery gloss; below it is white; the fins are dark, and the eyes red. Buchanan supposed that of all fishes he had met with in India, the *Nandin* has the greatest resemblance to the European Carp, but that many of its qualities are different; to this I may add, that it wants the dorsal and anal spines of *Cyprinus carpio*, while it differs from *Cyp. fimbriatus*, Bl. in having cirri, as well as a much longer dorsal.

### III.—CYPRINUS CALBASU, Buch.

Op. Cit. Pl. 11. f. 83. *Kalbasu*, and *Kundna* of the fishermen.

It is stated by Buchanan that this species is closely allied to the Barbel of Europe; and Cuvier on his authority referred it to that genus, although it has neither the short dorsal, nor the spines of the Barbels. Buchanan's figure though tolerably characteristic, presents the operculum too much rounded, and in his description the dorsal is said to be straight above, although it is falciform, and the nostrils to have but one aperture on either side. Buchanan was aware of the existence of two varieties of this species, and it strikes me he has applied the description of one, to the figure of the other. The following seems to me to be the variety he has figured. General colour deep leaden blue, scales dotted, fins dark, lips pendulous and fimbriated, forty-two scales on the lateral line, fourteen in an oblique row from the base of the ventrals to the dorsum. Fin rays, D.15 : P.17 : V.9 or 10 : A.8 : C. $\frac{10}{5}$ . There is yet a third kind, probably a distinct species, with red ventrals and forty scales along the lateral line, and twelve in an oblique row from the base of the ventrals to the dorsum.

The following is a description of the other, or ferruginous variety, *Kundhna* of the natives:—

The length from the operculum to the base of the caudal is four and a half lengths of the head, which is small and fleshy. The posterior margin of the operculum is equally rounded forming part of a circle, and the eyes are placed intermediate between the branchial aperture and the snout. The dorsal is placed somewhat nearer to the caudal than to the head, and forty-two scales are ranged along the lateral line, which is but slightly depressed over the pectorals; fifteen scales form each oblique line extending from the base of the ventrals to the dorsum on either side; the ventrals are placed a little behind the dorsal. The fin rays are,

D.16 : P.15 : V.9 : A.7 : C.20.

It is observed by Buchanan that in some places, as at Moonghyr where the Ganges is clear, passing over a pure sandy or rocky bottom, many of the scales assume a ferruginous colour, and the fish is supposed by the Natives to be a different species, which they call *Kundhna*, though he has no doubt this difference of colour is accidental. Buchanan farther remarks, that this species is very common in all the rivers and ponds of Bengal, and that it is also found in the Western Provinces about a foot and half in length, and sometimes even twice that size, and is a well flavoured light food, but contains many small bones. In general, Buchanan observes, it is of dark colour with a silvery gloss, inclining to yellow, and the scales are covered with numerous black dots. It is a very common fish in the Calcutta market.

#### IV.—CYPRINUS ROHITA, Buch.

Pisc. Gang. Pl. 36, f. 85, t. 41, f. 2.

The head of this species is a third longer than that of *C. calbasu*, and is equal to the depth of the body, while in the latter species the length of the head is little more than about half that depth. Before I was aware of the

existence of several varieties of this species, I thought Buchanan's figure the very worst imaginable, in as much as it does not correspond with his description; in proof of which it is only necessary to mention that although he correctly says the mouth extends straight backwards, i.e. horizontally, yet the figure places its orifice under the head half way between the snout and the eyes, as in the *Gonorrhynchs*; but when the mouth of *C. rohita* is closed, the upper lip, which is rather thick and muscular, is drawn in front of the orifice of the mouth like a projecting snout. There is, however, a small sized variety very common in Calcutta, which corresponds very accurately in every respect with Buchanan's figure, while his description agrees with a larger fish, probably the one I have figured, though there are still other varieties, but they may all be considered as one species. The different characters which it presents are no doubt the result of domestication. The variety figured by Buchanan is constant in its characters, and may be described as having two minute cirri, one at either angle of the mouth; the length of the head is rather less than the depth of the body, which is almost equal to a third of the length. The back is green and gold coloured, diminishing on the sides; the upper part of the head, the dorsal, caudal, and anal are dark olive, the pectorals pale, ventrals red. There are forty-three scales on the lateral line, and twelve from the base of the ventrals to the dorsum. The fin rays are,

D.15 : P.16 : V.9 : A.7 : C.19.

This is the *Ruce* figured by Buchanan. The following description refers to the one I have figured which is much larger, and very common in Assam; and it seems to me that Buchanan's description applies more to the latter than the former variety. I have stated the rays of the anal to be eight, while Buchanan makes them seven; the last ray of that fin is usually double, and sometimes it is difficult to say whether there be one ray more or less than a given number.

The dorsal is placed equidistant between the head and caudal, its base is equal to the length of the head and to one third of the body, and there are forty-two scales along the lateral line, and thirteen in an oblique line from the ventrals to the back. The operculum is the segment of a circle whose centre is placed on the posterior margin of the post operculum, a peculiarity which belongs to none of the adjoining species, and the eye is placed considerably nearer to the snout than to the branchial aperture. The fin rays are,

D.15 : P.16 : V.9 : A.8 : C.20.

This species is common, Buchanan states, in the rivers of the Gangetic provinces as well as in those of Ava, and I may add Assam. It is propagated, he says, in ponds with considerable care, being a most valuable fish, and its beauty, he observes, both as regards its form and colours, equals its value for the table. The same praise may however be with almost equal justice bestowed on each of the preceding species, which are generally, with the exception of the *Calbasu*, sold under the same name ; and indeed the fishermen are perhaps the only natives who are acquainted with their distinctions. With regard to their importance, it may be observed that there are no animals of more extensive utility, as they are equally used by all castes and classes. I believe, however, that in the North Western Provinces they are scarce, yet there is no part of the plains of India into the waters of which they might not be introduced and propagated to the greatest extent. In any attempts that might be made to this end, it would be necessary to attend not only to specific, but also to sexual distinctions ; it may be sufficient in this place to remark that the abdomen in female fishes is usually larger than in the males, while in the latter the branchial aperture and gills are somewhat larger, as Mr. Yarrell states, than in the former.

Having pointed out the distinctions between the foregoing species with sufficient minuteness to enable any one to recognise them, I may notice a few points connected with their general appearance and structure. In colour they

differ little from each other, the back is dark green in *C. rohita* and *C. nandina*, but it approaches more to olive in one variety of *C. calbasu*, and in another to dusky blue; below the colours vary from yellowish to reddish white, the sides often presenting an ochrey or occasionally a coppery iridescence or gloss. In all, the fins generally are dark, and the rays composing the pectorals slender, while those of the ventrals and anal are more stout and coarse. After they are caught the eyes and skin covering the edges of the opercular plates become bloodshot, an appearance not to be taken for a natural colour.

Although, as appears in the description of each species, the head differs considerably in size, it may generally be described as short and conical, flattened slightly above. The mouth is small and circular, and when opened occupies the apex or anterior part of the head, but at other times a slightly muscular snout closes it in front; the lips and cirri are pendulous, and the former in particular are strong and muscular, and may be supposed to be used for collecting worms, loose seeds, and other detached objects from the bottoms of muddy waters, such as ponds, jeels, and sluggish rivers. Indeed the frequent examinations that I have made of the contents of their abdominal canal places the certainty of this beyond supposition, at the same time it is necessary to observe that vegetable substances constitute by far the largest proportion of their food, which would seem to be obtained by stirring the deposits at the bottom of stagnant waters by means of the snout and its appendages.

In *C. calbasu* the stomach is a lengthy sac gradually narrowing to the capacity of the intestine, which is extremely long and loaded with a grey opaque matter, which seems to change in its passage through the intestines to a leaden hue; sometimes the contents of the intestine are greenish, but I have seldom found the scales or testaceous parts of other animals in the stomach of any of these species.

The liver is a dark red coloured organ consisting of three elongated lobes, the gall-bladder is large, and the air vessel is divided into two cells, the posterior of which is smaller than the anterior.

V.—CYPRINUS GONIUS, Buch.

Op. Cit. Pl. 4, f. 82. *Goni* of the fishermen.

Snout very muscular and perforated with pores, scales minute, intestines larger than in the preceding species, and loaded with a green vegetable pulpy matter. The fins large, their rays are,

D.15 : P.17 : V.9 : A.7 : C.19.

Buchanan observes that this species is very tenacious of life and strong, attaining a foot and a half in length, though it is little valued as food. Above it is of dark green colour, and the sides are marked with longitudinal dotted lines presenting an analogy to the *Perilamps*.

VI.—CYPRINUS NANCAR, Buch.

Op. Cit. 299.

This species I have not met with, nor is there a drawing of it in Buchanan's collection ; there can be no doubt, however, from the description given in the *Pisc. Gang.* that it belongs to the *Cirrhinus*; the mouth is small, surrounded by thick crenated lips, the snout projects slightly in front of the mouth, the head is fleshy so as to conceal the bones of the operculum, which perhaps induced Buchanan to suppose the sub-operculum to be wanting, or that each operculum is formed of a single bony plate.; in other respects it bears a resemblance to *C. rohita*, but the important peculiarity of the operculum and thick covering of the opercular plates, evince perhaps a closer affinity to *Catastomus dyocheilus*. The fin rays are,

D.20 : P.18 : V.9 : A.8 : C.20.

## VII.—CYPRINUS MORALA, Buch.

Op. Cit. Pl. 18, f. 91, P. 331. Hardw. Illust. Pl. fig.

The head is equal in length to the altitude of the body, and to a fourth of the entire length, including the caudal fin; the lips are pendulous, the hinder one fimbriated on the edge; the fin rays are,

D.13 : P.16 : V.9 : A.8 : C.19.

This fish was found by Buchanan in the fresh water ponds of Bengal, where it reaches the size of a small herring. All the preceding species were placed by Buchanan with his true Cyprins, forming the fourth division into which he separated the family, and this species, which is ranked with his seventh division, is also here placed with the Cirrhins, from its general accordance with them in form; but there is one peculiarity which it possesses in common with the two following species, and which has been overlooked in both figures that have been published, namely, the transverse tendency of the colours descending in the form of faint bars from the back across the sides, very beautifully shewn in Buchanan's original drawing, though not mentioned in his description. This, together with their having a black spot at the end of the tail, induced me to describe the three species in question under a separate division in the outline of the family, for until we are acquainted with their habits, and the structure of their stomach and intestines, we have no means of deciding as to the genus to which they may belong.

## VIII.—CYPRINUS DERO, Buch.

Op. Cit. P. 22, f. 78, P. 278.

*Cyp. dhenro*, id. Coll. *Dhengro* of the fishermen.

This species seldom exceeds four inches in length; its markings are similar to those of the last; it has only two cirri, and the fin rays are,

D.13 : P.18 : ? V.9 : A.7 : C.19.



Buchanan observes that the colours of the back and belly are regularly indented into each other on the sides, there is also a dark spot at the end of the tail. The snout projects a little in front of the mouth, is thick and perforated with mucous pores, or what Buchanan names, callous points. In the *Gang. Fishes* this species is placed with the Bangons or Gudgeons, to which perhaps it belongs.

IX.—CYPRINUS JOALIUS, Buch.

Op. Cit. p. 316.

*Cyp. jayali*, id. Coll.

This species has four cirri, with a dark spot at the end of the tail, and a similar distribution of obscure bars on the sides with the two preceding species, though it is placed by Buchanan in his fifth division. It grows to about three inches in length, and is common in the ponds and ditches in the north-eastern parts of Bengal; it is a brownish green colour above, and silvery beneath, the two colours uniting alternately in bars on the sides. The fin rays are,

D.11: P—? V.9: A.8: C—

The form of the mouth appears to be nearly the same as in the two last described.

SUB-GEN.—LABEO.

The Labeos agree in structure and habits with the Cirrhins, but have no cirri.

I.—CYPRINUS CURCHIUS, Buch. .

t. 40, f. 3.

*Kurchi* of the Bengal fishermen, and *Courie* of the Assamese.

This species differs from *C. gonius*, Buch. in being destitute of cirri, and in having somewhat smaller pectorals; its length, exclusive of the caudal,

is rather more than thrice the altitude; the scales are very small, and extend in rows along the sides, seventy-eight in each row, and thirty in an oblique row from the base of the ventrals to the dorsum; the head is less compressed than the body. The fin rays are,

D.16 or 17 : P.15 : V.9 : A.7 : C.19.

The lips are continuous round the mouth, double and fimbriated on their margins, and formed for collecting a loose soft food of a confervoid kind, which occurs abundantly in most of the waters of the plains of India, and the remains of which is plentifully found in the intestines.

The stomach is a long tapering tube, which terminates gradually in an extremely lengthy but narrow canal, which instead of being disposed in circular or serpentine convolutions, appears coiled in complicated meshes which occupy more or less of the abdominal cavity, according to the state of ingesta at the time the specimen is examined. The waters in which this species appears to delight, are the larger rivers where the currents are sluggish, and the banks formed of sand or mud; or extensive jeels, such as those on the north-eastern side of Bengal. It seldom attains a greater size than a foot in length, is excessively bony, and rather insipid as an article of food.

The variety of this species described by Buchanan under the name of *Cyp. cursa* is distinguished by four cirri, and eight rays in the anal fin. The following are the characters of one which is common in Calcutta—seventy-eight scales along the lateral line, thirty-eight in an oblique row from the base of the ventrals to the dorsum; under lobe of the caudal smaller than the upper; no cirri; intestines and stomach thirteen lengths of the entire animal. The fin rays are,

D.17 : P.16 : V.9 : A.7 : C. $\frac{10}{9}$ .

Plate 59, figs. 1, 2, represent the structure and disposition of the scales. Were I sure that my collection is complete in the varieties described

by Buchanan, I would add further figures of the structure of scales in this part of the family; but having some doubts on the subject, I must allow this group as well as the Cirrhins and Barbels, to stand for the present with some obscurity as to the number of species that belong to them.

## II.—CYPRINUS CURSIS, Buch.

t. 38, f. 3.

Buchanan observes that it inhabits fresh water rivers and ponds in the south of Bengal, and is often found from two to three feet in length; it is full of bones, and many of the natives abstain from its use, imagining that if eaten on the same day with milk it will occasion a disease called elephantiasis.

The figure above referred to is taken from a dry specimen, and was lithographed before I was aware of the existence of an excellent figure in Buchanan's collection, which I consider to be a male individual of *Cyprinus curchius*, though he has given it one ray less in the dorsal and one more in each of the pectorals, yet I have examined so many specimens that I cannot but regard both as belonging to the same species.

Its length, exclusive of the caudal, is rather more than thrice the altitude of the highest part of the body. There are eighty-three scales on the lateral line, and twenty-seven in an oblique row from the base of the ventrals to the dorsum. The dorsal fin is placed on the middle of the back, equidistant from the snout and the caudal. The head is less compressed than the body, the eyes are placed high, and the crown is flatly arched from side to side; the lips are fimbriated and continuous round the mouth, and formed for collecting loose floating plants, such as are abundant in jeels and creeks; the snout is also furnished with two small cirri, too minute to be of much evident utility. The gill covers are full and gracefully rounded behind; the caudal and dorsal fins are large, the others less fully developed. The fin rays are according to Buchanan, D.15 : P.18 : V.9 : A.7 : C.19—or, as I have found them,

D.16 : P.17 : V.9 : A.7 : C.<sup>10</sup>/<sub>5</sub>.

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The stomach is a small tapering tube terminating gradually in an extremely lengthy canal, and instead of encircling the abdomen, the whole is twisted spirally round the stomach. The contents of the canal is a green soft vegetable substance like chopped cabbage.

Its usual size is from twelve to four inches long; the colour is green above and silvery below. It is a beautiful fish, common in Bengal and Assam as high as Sudyah, but being full of bones is little valued as an article of food. If it be less useful in this respect than other Cirrhins, it is more serviceable than we are aware of, in common with the numerous Gudgeons, in clearing the indolent waters of the plains from a redundancy of vegetation with which they would be otherwise choked up.

I am not sure that these small scaled species might not be formed into a sub-genus with the Tench.

### III.—CYPRINUS DYOCHEILUS, J. M.

P. 37, f. 1. *Goreah* of the Assamese.

It is without cirri, but the under jaw is identical with that of the Cirrhins, while the snout and maxillary are covered with thick muscular cushions. It is found in the clear active currents of the Bramaputra from Middle Assam to the rapids at the extremity of the valley, but appears to be equally unknown in mountain torrents, and sluggish rivers and jeels in the plains. The head is elongated, and covered with thick integuments which envelope the operculum and branchial rays; the eyes are small, and placed almost in the posterior third of the head; the depth of the body is equal to about a third of the length; forty-four scales are placed along the lateral line, and thirteen in an oblique line from the base of the ventrals to the dorsum. The dorsal fin is placed midway between the plane of the head, and that of the anal, and all the fins but the dorsal are largely developed, and indicate considerable powers of motion. The fin rays are,

D.12 : P.18 : V.9 : A.8 : C.19.

The colours are bluish or brownish black above and on the extremities of the fins, but bluish white along the belly; the sides are also bluish-white with various stains of red and yellow on the shoulders.

On a closer examination of its structure, the limbs of the lower jaw are found to have a stronger ligamentous attachment in front than was observed in the true Cirrhins, while the articulation behind to the pteroplatine bones is considerably weaker, and the maxillary apparatus forming the front of the upper jaw is remarkably strong, the intermaxillary having firm articulations laterally with the outer sides of the apophyses of the limbs of the lower jaw, proving clearly that whatever power such a structure is intended to exercise, must be rather adapted to the crushing of detached objects, than the separation of such as are fixed or rooted to the ground, which would require a strong abutment of the jaw behind, as in the Gonorhynchus. Hence we may infer, that the bruising of shells and seeds is the peculiar object of its existence. In its search for such food, it would naturally be led to shallow waters on banks of sand and boulders where shell fish and drifted fragments of plants are most common, and the dangers to which it is exposed in such situations from birds and other animals, as well as of being left above the retiring currents, would be more to be guarded against than in species inhabiting deeper waters; hence those fins on which the velocity of its movements depend are large; and like all those species that inhabit rapid currents, its snout is perforated by numerous pores, from which an abundant slimy secretion is carried backward over the body by means of its motion through the water, the friction or resistance of which is thus diminished; this use of the mucous from the nasal pores of fishes I derive from Mr. Yarrell. The still more copious mucous secretion enveloping the bodies of Loaches and other *Apalopterineæ* we may presume is given them as a means of escape from enemies, rather than to facilitate their movements in the water, as they are not expert swimmers. Nothing can better illustrate this, than that in Gudgeons destined chiefly to inhabit stagnant waters, and not formed for very rapid swim-

ming, the scales are remarkably rough. With all its dexterity and rapid swimming this species is more exposed to the nets of the fishermen than most other fish, and its native name is said by the fishermen to be derived from the instinct and agility it displays in attempts to elude them. According to the observations of Mr. Griffith, it is found in Upper Assam in the early part of the cold season, generally keeping near the surface in deep water at the foot of rapids; in such situations it declines all sorts of bait and flies, but is a highly esteemed article of food. In the lower parts of the river, where I saw it in Middle Assam about the end of February, its flesh was considered coarse, and its haunts were then in shallow waters, perhaps for the purpose of spawning, which may account for the slight discrepancies regarding its qualities and habits.

Its usual size is from one to two and a half feet in length, and though sometimes coarse, its flesh is always well flavoured.

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## II.—GEN. BARBUS.

Lower jaw composed of two lengthened limbs united in front so as to form a smooth narrow apex; the dorsal fin is preceded by a strong spinous ray; lips hard, four cirri, intermaxillaries protractile.

They seem to live less exclusively on a vegetable regimen than most of the Cirrhins, from which group they also differ in the form or sculpture of the body, as well as in possessing a shorter intestinal canal. The dorsal which is small commences half way between the caudal and the snout, the ventrals are opposite to it. At the insertion of the anal the body contracts suddenly in depth, leaving an abrupt tail about half the depth of the body, approaching to what we see in the Lizards. The body is more slender, the fins smaller, but the rays of which they are composed are larger, and the colours perhaps brighter than in the Cirrhins. In the latter the head is thick, and the subor-

bitar plates are narrow and nearly of equal breadth; but in the Barbels the head is compressed, and the suborbital apparatus forms broad plates behind, and narrow ones below the eyes; and it is on this difference in the breadth of the suborbital and postorbital plates that the length of the head in Barbels depends. The lower jaw is equal in length with the upper, and is formed of two lengthy bones having each a large pterygoid plate for the insertion of proportionally large muscles for drawing the jaws together; the mouth is horizontal, and at the chin the limbs of the lower jaw are soldered firmly together, where they form a narrow but smooth symphysis. Fig. 6, t. 54, represents the left ramus of the lower jaw of *Barbus hexastichus*; c, side view showing the pterygoid plate, d under side; a, point of union with its fellow at the symphysis, b, articulating surface behind.

# I.—B. HEXASTICHUS, J. M.

t. 39, f. 2.

*Cyprinus tor*, Buch. *Lobura* of the Assamese.

Head small, postorbital plates equal to half the space between the eyes and the maxillaries. The relative length of the head to the entire length is as two to seven; twenty-five scales are ranged along the lateral line, and six in an oblique line from the base of the ventrals to the dorsum. The fin rays are,

D.11 : P.17 : V.9 : A.8 : C.19.

The three first rays of the dorsal are closely united and bony, the fins are short, and with the exception of the pectorals the rays of which they are composed are strong and coarse. The colour of the back, bases of the caudal and dorsal are greenish grey, as well as the upper part of the head; the rest of the fish is reddish yellow, with the tips of the fins a more decided red.

I found this species in Assam, and Buchanan met with it in the large rivers on the western side of Bengal; but the species he has figured for it in

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his collection is *B. progeneius*. It seems to delight in the clear brisk currents of large rivers, passing during the dry season into shallow tributaries to deposit its spawn; I am not aware of its being found in the jeels and muddy rivers of Bengal. Buchanan mentions it as growing to three or four feet in length; those I saw in Assam varied from twenty inches to two and a half feet. As an article of food it equals the *Ruee*, and might be extensively propagated, especially in low hilly districts where that fish would not answer so well.

## II.—*B. PROGENEIUS*, J. M.

t. 56, f. 3.

*Jungha* of the Assamese.

Length of the head to that of the body as one to three; scales large and rounded posteriorly; twenty six along each lateral line, and six from the base of each ventral to the dorsum. Fins short. The number of rays are,

D.12: P.16: V.9: A.7: C.19.

The head is long and much compressed, the mouth is narrow and small, and from the lower lip a fleshy appendix is extended, by which it is distinguished from the neighbouring species; nevertheless it is figured in Buchanan's collection of drawings as *Cyp. tor*, to which it bears so close an affinity that he may probably have considered it to be the same. The intestines are capacious, and consist of four convolutions extending along the posterior half of the abdominal cavity, leaving the anterior portion of that cavity chiefly to the stomach and liver. The first is a conical sac (larger than the stomach of the *Cirrhins*) occupying the right side, and terminating simply in the intestine. The liver is broad consisting of several lobes, chiefly placed on the left side of the stomach.



## III.—B. MACROCEPHALUS, J. M.

t. 55, f. 2.

*Burapetea* of the Assamese.

Length of the head compared to that of the body as two to five, twenty-seven scales along the lateral line, and six in an oblique row from the base of the ventrals to the back ; fins short, and formed of strong rays as follows,

D.11: P.16: V.10: A.7: C.<sup>\*</sup>19.

The postorbital plates are broadly expanded ; the eyes are placed in the anterior third of the head, equidistant between the preoperculum and the intermaxillary bones. The mouth is large and protractile, the lips smooth and round, the jaws and intermaxillaries strong and covered, as well as the interior of the mouth, with an uninterrupted extension of the outer skin.

The stomach and intestine are a simple continuation of a single canal consisting only of two convolutions ; the liver is large, and envelopes the stomach and intestines with its broad and elongated lobes.

Mr. Griffith caught many with live bait, some as weighty as 20 and even 30 pounds : smaller individuals are however taken with flies, and he remarked of this and another fish very nearly allied to it, called by the natives *Mahaseer*, that they are so extremely voracious and carnivorous in their habits as to swallow any of the smaller fishes that approach them. This is exactly what might be expected in one of the most typical species of a sub-typical group, for although the Barbels belong to the *Pænominae*, or herbivorous sub-family, yet as a natural group, it should according to the law of symbolical representation have its carnivorous forms, and from the prevalence of these among the Barbels I have made this genus the sub-typical, or destructive group of the *Pænominae*.

The only individual I have had an opportunity of examining was caught in deep clear water at the commencement of the rapids, and was three and a

half feet in length. They are in great request in the market at Suddyah, being a fine wholesome food. They might be propagated in hill streams, but their voracity would be a decided objection to their introduction to fish ponds.

IV.—B. HEXAGONOLEPUS, J. M.

Pl. 41, f. 3.

*Bokar* of the Assamese.

Length of the head to that of the body is as one to four; twenty-seven scales along the lateral line, and seven in an oblique line from the base of the ventrals to the ridge of the back. On the anterior part of the body the exposed surfaces of the scales represent hexagonal outlines, the fins are placed as in the preceding species, but the rays of the ventrals as well as those of the pectorals are small. The fin rays are,

D.12: P.16: V.9: A.7: C. $\frac{10}{9}$ .

The head is small and little compressed, the snout smooth and slightly rounded, and the postorbital plates less expanded in this than in any of the other species, having a smooth dorsal spine and large scales. In large sized individuals the back and head, base of the fins and scales are blackish grey; but the opercular plates, scales, and fins are tipped with yellow. In young ones a leaden hue supplies the place of yellow, and the fins are tipped with black.

The stomach is about the length of the body, gradually contracting till it joins the intestines, which are thrice the length of the stomach, but of great capacity, expanding in size from their commencement, to about the middle of their length, and again gradually contracting until they reach the vent. In the stomach and intestines I found numerous minute bones of small fishes. Instead of the intestines of this species being disposed in transverse or longitudinal folds, they are convoluted transversely. Mr. Griffith remarks that the *Bokar* is to be found in all large rivers on the eastern frontier, from the base of the mountains to the situation at which the currents first become languid

in the plains, keeping mostly in the middle of the stream, where it takes a red hackle very freely, as well as worms and other bait. It is very powerful, often attaining two feet and upwards in length, and usually weighing from eight to twelve pounds.

There is still another large species *Cyp. pitutora*, Buch. closely allied to the preceding Barbels, which according to Buchanan sometimes attains nine feet in length;\* it has the following rays in its fins,

D.11: P.15: V.9: A.7: C.19.

The head is said to be blunt, oval, and small, with a protractile mouth, and the scales to terminate with a notch behind. The first of these characters would seem partly to refer it to *B. hexagonolepus*, while the notch at the apex of the scales is only apparent in *B. macrocephalus*. There is no drawing in Buchanan's collection of the species alluded to, and as his description is not sufficiently clear, we must for the present consider *Cyp. pitutora* as a doubtful species.

V.—B. MEGALEPIS, J. M.

*Cyp. mosal*, Buch.

Hardw. Illust. Tab. 93, f. 1.

The only specimen of this species I have seen is contained in a small collection of fishes presented to the Society by Mr. Hodgson. Its principal difference from the last described consists in its having a longer head, which is

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\* The proportional depth of such an individual could not be less than two feet. Mr. Yarrell alludes to a Carp, the largest he could find any record of, and which weighed twenty-two pounds; but it appears from a notice in the Phil. Mag. Aug. 1837, that a Carp twenty-three pounds weight had been found in England in 1771. There can be no doubt however that the Barbel alluded to by Buchanan must have been twice that weight at least, and that twenty-three pounds is an ordinary weight of many of the Indian species of this and the last described genus.

narrower and more compressed at the snout; but as the contents of the abdomen were removed from the only specimen examined, I have been unable to ascertain whether the digestive organs possess any peculiarities.

The head is equal to one-third of the body in length, twenty-six scales are ranged along the lateral line on either side, and six in each oblique row from the base of the ventrals to the dorsum. The fin rays are,

D.12 : P.15 : V.9 : A.7 : C. $\frac{10}{9}$ . Or, according to Buchanan—

D.13 : P.17 : V.9 : A.8 : C.19.

The first four rays are said by Buchanan to be united in the dorsal, while I can only observe three to be thus joined, which may reconcile my twelve with his thirteen; and as the last ray of the anal is double, Buchanan may have reckoned eight where I have only seven.

The *Mosal* was found by Buchanan in the Kosi river, on the northern side of Bengal. Mr. Hodgson's specimen came, I presume, from the same quarter, where Buchanan observes it sometimes attains four or five feet in length, and that it is of a long, compressed, but thick form, more prominent above than below; its colours are shining green on the back, softening into silvery on the belly: the head, he says, is sharp, oval, and narrower than the body and smooth, with a small tubercle (not however a peculiar mark) between the nostrils which are near the eyes; the mouth is low and horizontal, with rounded and smooth lips; the lower jaw is rather shorter than the upper.

The Native names *Mahasaula*, *Mahaseer*, and *Tora*, variously corrupted, probably referring to the size of the scales or the head, are without discrimination applied by the Natives of Bengal and Assam to the preceding five species, the scales of which are so large that Buchanan informs us gaming cards are manufactured from them at Dacca. They appear to be confined to the rapid and clear currents of the larger rivers along the skirts of mountains, and are therefore only met with in the northern and eastern parts of Bengal, as well as Upper Assam. Their flesh is free from the numerous small bones that lessen the value of many otherwise important species, and afford an excellent,

wholesome, and nutritious food. These fishes are, however, peculiar to remote unpopulated districts where no attempts are made to cure them, they are consequently lost to the wants of other places where an unlimited demand for dried fish must prevail at all seasons, but particularly during the rains and hot weather, when fresh fish become scarce.

There can be no doubt that if some relaxation of salt duties could be made in favour of those who would embark in such a business, a profitable and useful trade might be established to a far greater extent than we can at present form any notion of. The season for fishing is short, and without the means of saving more than can be consumed when fresh, the fishermen have nothing to stimulate them to any exertion beyond that of earning during their brief season, a sufficient sum to support them during the rest of the year. Had the fisherman the means of preserving the results of his labor, his chief market would commence when the fishing season ends, and his industry would then become a permanent benefit to himself and to the country at large. Sea fisheries would be of still higher importance, although neither should be neglected.\* The cold season, from November to February, is the time at which fishes are chiefly taken; the waters being then low the fish are confined to narrow channels, and are often completely cut off from the larger streams and left in pools, in which they are easily secured. When passing Solano Mookh with the Assam deputation in January, I saw boats laden with most of the five kinds of Barbels just described, from one to two and a half feet in length; but as Suddyah, the nearest market at which they could probably be disposed of, was thirty miles distant, and a strong current to be opposed in reaching

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\* The attention of the Royal Asiatic Society was directed to this subject in April last, by my friend Dr. Cantor, whose opportunities of making himself acquainted with the subject during the time he was employed with Capt. Lloyd in the *Sunderbunds*, should render his opinions of considerable weight. Since then the discovery of isinglass in a large *Polynemus*, which frequents the estuaries of the Ganges in shoals every cold season must, if thoroughly established, be the means of opening a new and inexhaustible branch of trade in a quarter where it was little expected.

that place, and no means of curing the fish, the owners entertained little hopes of realising any thing whatever by them.

VI.—*BARBUS CHEILYNOIDES*, J. M.

t. 57, f. 5.

Journ. As. Soc. Beng. 1838, t. 56, f. 5.

For this species we are indebted to Dr. Macleod, who found it in the mountain streams at Simla.

The length of the head to that of the body is as one to two and half, intermaxillaries protractile, lips round, smooth, and thick, with four cirri. The body contracts suddenly under the dorsal and over the insertion of the anal fin; there are thirty-three scales along the lateral line, and nine in an oblique row from the base of the ventrals to the dorsum. The fin rays are,

D.10 : P.16 : V.9 : A.7 : C.18.

The three first rays of the dorsal are united and spinous, the pectoral fins are small, and their rays slender in proportion to those of the ventrals.

The intestine and stomach are a small and continuous tube equal to about twice the entire length of the animal.

The thick lips and blunt profile of this species give it somewhat the appearance of *Cyp. chedra*, Buch.; its usual length appears from Macleod's specimens to be from four to six inches, but it may attain a larger size.

VII.—*CYP. SARANA*, Buch.

Op. Cit. p. 307. *Cyp. Kunta*, id. Coll. *Cyp. Kunomoo*, Russ.

The first two rays of the dorsal are spinous, the second finely serrated behind; the head is blunt, oval, small, and smooth, with a small bone at either side of the upper lip. The fin rays are,

D.10 : P.16 : V.9 : A.8 : C.19.

The colour is green above, below silvery ; scales large. Such are the only characters of value given of this species by Buchanan, who supposed it to be probably identical with *Cyp. kunamoo*, Russ., though the dorsal of that species contained only nine, and the anal only seven rays.

VIII.—B. SPILOPHOLUS, J. M.

Pl. 39. f. 4.

*Cyp. chagunio*, Buch.

Length of the head to that of the body is as one to three, head much compressed, eyes equidistant between the snout and the branchial aperture, suborbital plates narrow, cheeks and snout porous, the latter abrupt, depressed, and projecting in front of the mouth which is low, narrow, and horizontal ; dorsal margin sharp in front of the fin ; the third ray of the dorsal finely serrated behind, the last is double. The fin rays are,

$$D.11 : P.15 : V.9 : A.7 : C \frac{10}{9}$$

Forty-seven or forty-eight scales are placed along the lateral line, and sixteen or seventeen in an oblique line from the base of the ventrals to the dorsum, with a black diffuse spot at the base of each scale ; colour blackish grey along the back, changing to bluish white below. The specimen from which the description and drawing were taken, was presented to the Society by Mr. Hodgson, and had the two last rays of the anal prolonged to extended filaments ; the species is probably the same as the following, which like *C. sarana* is said to have large scales,\* but if we compare the scales of

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\* The fin rays of *Cyprinus chagunio*, Buch. correspond with those of *Cyprinus pitulora*, id. ; but in the former, the dorsal spine is serrated, and in the latter it is smoother behind ; in the former there are but twenty-six scales along each lateral line, in the latter forty-eight. The Indian Barbels may be conveniently divided into two sections, namely—species with large scales and smooth dorsal spine, and species with smaller scales and serrated dorsal spine. This group as well as the Cirrhins requires to be made the subject of a distinct monograph.

*B. spilopholis* with those of most other Barbels we must consider them as small, though they are large compared with those of *B. progastus*. The whole of our Indian Barbels, as well as Cirrhins, will however require much further investigation and revision.

The scales of *Cyprinus chagunio*, Buch. are spotted at the base, and the head is compressed, with round tubercles distributed on its fore part. The fin rays are,

D.12 : P.17 : V.10 : A.8 : C.19.

Colours above green, below silvery. It was found by Buchanan in the Jumna and the northern rivers of Behar and Bengal, and is said to be an excellent food.

IX.—*B. DILICIOSUS*, J. M.

t. 39, f. 3.

General figure short, head blunt, mouth directed obliquely upwards, suborbital plates narrow, thirty-four scales along the lateral line, and eleven in an oblique line from the base of the ventrals to the back. Dorsal preceded by a spine finely serrated behind. Fin rays are,

D.12 : P.16 : V.9 : A.7 : C.19.

Colour bluish grey above, but bluish white beneath, with a diffuse golden stain on the operculum.

The stomach of this species extends the whole length of the abdominal cavity, and contracting slightly terminates in an intestine of moderate length, which is merely reflected once a short way back upon the stomach and thence is extended to the vent.

The ordinary length of the species is about ten inches. It is found in languid streams on sandy bottoms in Upper Assam, and is considered an article of luxury from its fine sweet flavour, wholesome qualities, and probably also from its comparative scarcity. It is one of those species that might be introduced with advantage, and propagated extensively in fish ponds in Upper India. It seems to approach very nearly to the Perilamps, as well from its



upturned mouth, its small size compared with the other Barbels, its shorter abdominal canal, and the bright spot or golden tinge on the operculum, while the absence of the tooth on the lower jaw, and of stripes or spots on the body, and the small anal, are characters which must place it with Barbels.

SUB-GEN.—OREINUS, J. M.

Mouth directed downwards, lower jaw shorter than the upper, snout muscular and projecting, furnished with cirri. Dorsal preceded by a serrated spinous ray. Scales small. Intestinal canal and stomach form a more or less capacious tube from five to six lengths of the body.

The only three species known are herbivorous; with one, *O. progastus*, I have been acquainted since my visit to Upper Assam, a second was brought down by Mr. Griffith in June last from Boutan, and a third still more recently by Dr. Macleod from Simla. It was not until I received this last, that I was fully impressed with the necessity of separating them from the true Barbels, not only on account of their herbivorous habits, but of their peculiar form, and the structure of their mouth, which altogether indicate a relation to the Gonorhynchs, while the intestinal canal and dorsal spine bring them closer to the Barbels, as a subordinate part of which genus we may still consider them.

I.—*O. PROGASTUS*, J. M.

Pl. 40. f. 4.

*Adoce* of the Assamese.

This species is easily known by its lengthened and fleshy snout, small mouth, and the suborbital bones forming a narrow band below and behind the eyes, dorsal fin anterior to the middle of the body, with a strong ensiform spine toothed behind; the abdomen is abruptly enlarged beneath the pectorals, by which character alone it is readily distinguished from all other species of the

family ; the scales are small, and the body much compressed. The fin rays are,  
D.12 : P.13 : V.10 : A.7 : C.19.

The stomach is of considerable size ; and of a dark reddish brown colour ; the intestines are a simple continuation of the stomach, and are of moderate length, soft, dark coloured, and filled chiefly with a vegetable pulpy matter.

This species is said by the natives of Assam to occasion swimming of the head and temporary loss of reason for several days, without any particular derangement of the stomach ; the cause of which I shall endeavour to account for in noticing similar effects produced by some of the Gonorrhynchs. It is the most herbivorous of the Barbels, and like some of the Gudgeons tends rapidly to decay after death, and in the abdominal cavity a copious oily secretion is found which is probably the cause of its bad effects.

Mr. Griffith, who is better acquainted with the habits of this species than I am, remarks that it is chiefly found in rivers, along the borders of Assam, where the stream is rapid enough to prevent any kind of navigation with boats or canoes ; that it attains six or eight pounds weight ; and that the fishermen informed him if eaten it occasions all the symptoms of drunkenness, which coincides with what I had myself learnt regarding its effects.

## II.—O. GUTTATUS, J. M.

Pl. 30. f. 1.

Labial filaments very minute, dorsal placed behind the middle, lower part of the second ray bony, and serrated behind, but soft and smooth at the top. Eyes and branchial apertures small, head covered with thick integuments, part of which form the branchial membrane and conceal its rays, body covered with very minute scales, lateral line extends straight along the sides which are marked irregularly with brownish spots, having a black elevated nucleus. The fin rays are,

D.10 : P.17 : V.11 : A.10 : C.20.

Colour brownish above, below silvery tinged with yellow.

We are indebted for our knowledge of this species to Mr. Griffith, who found it in the Monas, and other rivers in different parts of Boutan, between the elevation of two, and five thousand feet. It may occur higher, but Mr. Griffith remarks, that in vallies above five thousand feet though fine clear streams are common, yet fishes of any kind do not occur in them, and the natives assured the Mission to which he was attached, that no fish existed at such elevations.

The lower jaw is short and strong, composed of two deep bony limbs firmly soldered at the symphysis, and covered with a thick cartilaginous integument, similar to that which forms the same part in *Gonorhynchus petrophilus*; it is probably used as in that species for scraping confervoid plants from the surface of the rocks. The intestines are more capacious, but not quite so long as in the *Gonorhynchus*. Mr. Griffith remarks that though this species delights in rising above the surface yet it will not take flies.

### III.—O. MACULATUS, J.M.

Length of the head to that of the body as one to three and half, snout thick and muscular, and by its action the mouth, which is situated inferiorly, is opened and closed as in the genus *Gonorhynchus*.

There are four small cirri, and the lips are thick, hard, and smooth. Body above dark and irregularly spotted, the three first rays of the dorsal are spinous, scales very minute, suborbital bones concealed beneath a thick covering of integument. The fin rays are,

D.11 : P.18 : V.10 : A.5 : C.19.

Intestinal canal capacious, about four lengths of the body, and found to contain a copious green vegetable matter. *Habitat.* Mountain streams at Simla; ordinary length about six inches.

To these species must be added *Cyprinus Richardsonii*, Gray. Hardw. Illustrat. t. 94, f. 2, if it be distinct.

## III.—GEN. CYPRINUS PROPRIUS.

Body elevated, lower jaw short and rounded in front, lips hard, thick, and without cirri; dorsal long.

## I.—C. SEMIPLLOTUS, J. M.

*Sundaree* and *Sentoree* of the Assamese and Singphos.

Pl. 36, fig. 1.

The head is small and fleshy, depressed at the snout, which is thick and square, with a row of nine large pores extending horizontally round the nose.

The body is compressed and deep, the upper and lower margins unequally arched, the dorsal is long, and preceded by a spine. The fin rays arc,

D.27 : P.16 : V.9 : A.9 : C.19.

The colours along the back are greyish black, changing to bluish white along the sides. There are thirty-two scales along the lateral line, and ten in an oblique row from the base of the ventrals to the dorsal.

Mr. Griffith remarks, that the ordinary weight of this species varies from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  pounds, and that it is usually found near rapids; the larger ones in the deeper waters, where they are seen, particularly of an evening, rising to the surface, but they refuse all sorts of flies and baits, although if a stone be cast into the water, all these fishes in the vicinity assemble round the spot. The *Dhoms* (fishermen) take them by a casting net, observing great silence, and frequently first dropping a stone to assemble the fish in the spot on which it is intended to cast the net.

Structure.—The opercular plates and bones of the head are concealed beneath a thick skin, or integument. The intermaxillary is fixed to the maxillary bones, and these last to the nasal and suborbital plates, so as to

admit of no independent motion in the upper jaw, as in the European Carp, and most of our Indian Barbels. The pre-operculum is short, and forms, in conjunction with the anterior extremity of the inter-operculum, a convex articulating surface for the respective branch of the lower jaw, which proceeds almost transversely to meet that of the opposite side, giving the profile a shortened character. The sub-operculum is very small, as well as the branchial rays, which in this, as well as in *Catastomus dyocheilus*, and some of our Indian Gudgeons, and most of the *Gonorhynchi*, can only be seen on removing the integuments.

The stomach is a simple but lengthened sac, terminating in a very long narrow intestine; the abdomen contains an abundant supply of soft fat, in which the intestines seem to float.

This species, which is reckoned the most delicious in Assam, is found only in the upper parts of the province, where the currents become clear, and somewhat rapid. It is common at Suddyah, and is said to be found from thence to the foot of the mountains. Its usual size is from twelve to twenty inches in length, and from four to seven inches deep from below the pectorals to the shoulders. It contains few bones, and is rich, fine flavoured, and wholesome, and for these reasons always sells at a higher price than ordinary fishes. It is one which might be introduced with great advantage to hilly countries, especially to places in India selected as *sanataria*, where its superior qualities would soon render it a favourite dish, and the place perhaps a favourite resort to others as well as invalids.

The most suitable *vivarium* for this species might be formed by stopping up a clear mountain stream to a certain depth, and filling the irregularities of the bottom with sand, gravel, and stones; there should be a current in the water, and to prevent the escape of the fish, a grating should be fixed below; and at the opposite end a stronger grating, if necessary, to prevent the introduction of rubbish during floods, as well as the escape of the fish, should the fall not be sufficient for the latter purpose. *Barbus deliciosus* is another

species for which the same fish-pond would answer, and which it would be equally desirable and practicable to introduce to similar situations.

II.—C. CATLA, Buch.

Pisc. Gang. Pl. 13, f. 81—p. 287. *Catla*\* of the fishermen.

Buchanan says that this species differs from *C. carpio*, or common Carp of Europe only in wanting cirri, but it also differs from that species in the want of spinous rays in the dorsal and anal, as well as in general form. It approaches however much nearer to the Prussian Carp (*C. gibelio*) the general figure, character of the fins, and number of their rays, being the same in both; but they differ in the size of their scales and proportion of the head.

The length of the head is half that of the body (exclusive of the head and caudal), and its depth is equal to half its length. There are forty-four scales along the lateral line, and fourteen in an oblique line from the base of the ventrals to the back, the length of the dorsal is equal to about a third length of the body. The fin rays are,

D.18 : P.18 : V.9 : A.8 : C.19.

The lower jaw consists of two broad bony plates joined slightly in front, where they project a little before the upper jaw.

The *Catla* is said by Buchanan to be limited to Bengal, I found it however as high in the Bramaputra as Bishenath, although it is there less abundant than within the limit of the tides beyond the reach of brackish water; but it lives and attains great size in tanks and ponds quite unconnected with tides and currents, so that it is capable of being introduced wherever there is fresh water. There is no species of more importance than this in an economical point of view. Buchanan informs us that it is sometimes found four feet in length, and that it is a light wholesome food; the head, he remarks, is peculiarly delicious; this I can also answer for, and am only at a loss to know why it should have been so long overlooked by our epicures. Although

the *Catla* is one of the commonest fish in Bengal, Buchanan remarks that it is unknown in most parts of Behar. If a little attention were directed to the extirpation of Alligators, and other destructive animals in our tanks, there is no limit to the extent to which this, and similar useful species might be propagated.

#### IV.—GEN. GOBIO.

The Gudgeons, according to Cuvier, have both the dorsal and anal short, and are without spinous rays in any of the fins, or cirri to the mouth. As, however, we have some Indian species with two cirri, it is necessary to omit the consideration of those appendages in the characters of the genus, otherwise well marked by the lower jaw being shorter than the upper, without having the mouth directed downwards, as in the Gonorhynchs. The vent is placed close in front of the anal fin, and not between the ventrals, as in the Gonorhynchs; and in many of the species the liver is either altogether wanting, or dispersed in numerous small glands throughout the folds of the intestines. I have already remarked that cirri are very uncertain characters in this family, and that even among the Cirrhins themselves, a genus characterised by these appendages, it is often difficult to say whether they are present or not; and in the closely allied group *Labeo*, cirri are altogether wanting, though, if we may judge from what appear to be Indian species of *Labeo*, their habits and structure in other respects hardly differ from the Cirrhins. The Gudgeons as I have limited the group, are strictly herbivorous, and surpass all other fishes of the family in the length of the alimentary canal, which is from eight to eleven lengths of the body, inclusive of the head and caudal fin, and is always filled with a soft green pulpy aliment. The stomach is a long tapering tube, and differs only from the rest of the canal in the longitudinal direction of its muscular fibres; the lower jaw is composed of two bones soldered together at the symphysis; the lips are hard, with a slight ridge on the upper surface of the lower one in many of the species, a

character by which Buchanan distinguished the group under the native name *Bangon*, but the ridge in question, though commonly met with, is not universal, or peculiar to the group, as it is also observed in the genus *Mugil*, and besides, is very obscure.

The forms which come under this genus resolve themselves into three divisions—1st, such as have two minute cirri; 2d, those with a hard, round, and smooth snout without cirri; 3d, species with a rough, soft, and fleshy snout.

In the first of these divisions we have, 1. *Cyprinus mrigala*; 2. *Cyprinus curmuca*; 3. *Cyprinus reba*; 4. *Cyprinus angra*.

In the second division we have, 1. *G. lissorhynchus*; 2. *G. isurus*; 3. *G. limnophilus*; 4. *G. bicolor*; and 5. *G. anisurus*.\*

In the third division, 1. *G. ricnorhynchus*†; 2. *Cyprinus boga*; 3. *Cyprinus pangusia*; in all, eleven, which I have been enabled either to identify with Buchanan's species, or describe as distinct.

#### I.—CYPRINUS MRIGALA, Buch.

t. 88, f. 1 — P. G. t. 6, f. 79.

This is one of the most important of our Indian species, and was justly associated by Buchanan with his Bangons, though afterwards erroneously referred in the Règne Animal to the Cirrhins. It is the *Mrigala* of Sanscrit writers, and the *Mirga*, *Meerica*, &c. of the Bengal and Assam fishermen. The figure given of it by Buchanan is not well expressed, the head is too much flattened or depressed, the scales are represented too large, and there are other disproportions which to one well acquainted with the fish, give his figure an unnatural appearance, for which reason I have given another figure which has been care-

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\* These species are probably equivalent to *Cyprinus cura*, Buch. *Cyp. bata*, id. and *Cyp. acra*, id. I have however, been unable to reconcile them with Buchanan's descriptions.

† *Gob. ricnorhynchus*, J. M. is equivalent to *Cyp. falcata*, Gray Hard. Illust. t. — f. —; *Cyp. boga*, Buch. *Cyp. pangusia*, id. and *Gob. malacostomus* of my synopsis are probably but one species.



fully taken from life. The altitude of the deepest part of the body is contained four and a half times in the entire length, and the head and caudal are each equal in length to the depth of the body. There are forty-four scales along the lateral line, and fourteen in an oblique row from the base of the ventrals to the dorsum. The dorsal fin is placed somewhat nearer to the nape than to the base of the caudal fin, and the length of its base is equal to the depth of the body; the ventrals are placed opposite the dorsal, and the space between the anal and caudal is equal to half that between the former and the ventrals. The fin rays are,

D.16: P.17: V.9: A.7: C.19.

The eyes are placed almost in the anterior third of the head. Buchanan states that the pupils are circular, but I have found them oval, with the long diameter vertical. In the variety called *Rewah*, however, the pupils of those I have examined are circular, and if we could rely on such peculiarities as constant, they would afford an excellent character by which we might distinguish the species in very difficult cases.

The mouth is placed at the end of the head, having two small cirri placed anteriorly on the upper lip. The under jaw is formed of a very slender rim composed of two bones meeting in the middle at the chin, where they are soldered firmly together.

The outer extremities of these *ossa siagone*,\* as they may be named for convenience, are articulated above to the corresponding extremities of the intermaxillaries, and behind to the anterior extremities of what Cuvier named in the Perch, the *angular bone*. It has already been shown that the angular bones really form the lower jaw both in the Cirrhins and in the Barbels, with this difference, that in the one case they are united, and in the other unattached by a bony union in front. In the Gudgeons, however, and in this species in particular, the angular bones are nearly parallel to each other,

\* From Σιαγον, the jaw bone.

so that the front of the lower jaw is composed of the two transverse limbs *a*, *e*, *c*—Pl. 54, f. 2, above described: *a*, is the point of union with its fellow at the symphysis; *b*, the articulating surface behind; *d*, the body of the angular bone corresponding with the analagous bone in the Perch, and with f. 4, 5, 20, and 21, Pl. 54, in the Cirrhins.

The intestinal canal was found to be sixteen feet in length in an individual whose entire length was two feet, and loaded with a transparent viscid fluid, as well as a grey pulpaceous substance. The coats of the intestines are marked at short intervals by opaque muscular rings. The stomach is merely distinguishable from the intestines by the longitudinal direction of its fibres, and seemed to be without either cardiac or pyloric valves. The anterior extremity of the stomach in an individual of the dimensions already mentioned, was large enough to admit the finger, while the posterior extremity was about the size of a large goose quill. The liver is large, and consists of elongated lobes of dark red colour, extending along each side of the stomach. The air vessel consists chiefly of a great anterior cell of an almost cylindric shape, with rounded extremities; this is separated by means of a stricture from a balloon-shaped posterior cell of considerably smaller capacity.

I have entered thus fully into a description of this species, because it is not only one of our most valuable fishes, but in a scientific point of view, is to be regarded as the most perfect member of the group to which it belongs. Its superiority in the one respect being fully established by its bulk, and the frequency with which it is met with in the bazars as well as on our tables; and in the other, by the variety of its food, which consists, as well as I could determine from the contents of the stomach, of soft shell fish and vegetable matter, a diversity of aliment which requires a higher degree of intelligence to select, and a more perfect organization to procure and digest, than can be supposed to belong to the ordinary species, which appear to subsist exclusively on *confervæ*, and other plants that abound in the waters of ponds and swamps, where the Gudgeons of this country are chiefly found.

The *Mrigala* is most esteemed during the rainy season in Bengal, by Europeans at least; the usual size at which it is taken is from eighteen inches to two feet in length, when smaller the flesh is bony, and when larger it becomes coarse, and loses flavour. Its form is seemly, and the colours extremely rich, but undefined, generally consisting of dark green along the back, but sometimes brown, or both intermixed, with a gold-yellow iridescence on the sides: it is one of those species which might be propagated with advantage wherever a sufficiency of fresh water occurs. The *Rewah* I consider to be nothing more than the young *Mrigala*; I have not however found it any where but at Calcutta, and there are some interesting differences both in the disposition of the intestines, and the form of the air vessel in the two kinds, which deserve to be pointed out whether we regard those differences as constituting distinct species, or as elucidating the progressive stages of development in the same individual. In the *Mrigala* the anterior cell of the air vessel is large, constituting almost nine-tenths of the organ; in the *Rewah* the posterior cell is larger than the anterior. In the *Mrigala* the intestines are convoluted in longitudinal folds; in the *Rewah* the folds of the intestine are disposed obliquely across the abdomen, but the proportionate length of the alimentary canal to the size of the body is the same in both. The scales in both are of the same form, but the structure is somewhat different.

## II.—CYPRINUS CURMUCA, Buch.

Journ. Mysore, V.11, t.30.

This species is placed by Buchanan amongst his true *Cyprinus*, but from his figure, as well as his description, I am inclined to consider it as belonging to this place, although he says the jaws are protractile, a character which is not common in the Gudgeons, and which will require to be particularly inquired into hereafter. I am aware that to describe two different species under one name, is more calculated to create confusion than giving a new name to a species

described before ; at all events, the latter error is one that may be more easily corrected than the former. I have, however, a specimen in my collection which corresponds so closely with Buchanan's description, that I might almost venture to look upon it as the same. But in hopes that some member of the Society will forward to our Museum a specimen of the *Curmuca*, which is common in the rivers of southern India, I will withhold for the present any further notice of this species than may be found in the synopsis.

### III.—CYPRINUS REBA, Buch.

Had Buchanan not stated that the cirri of this species are appended from the end of the snout, instead of the corners of the mouth, I should have been disposed to refer the specimen which is alluded to above, to this species, which is common, he observes, in the north-western parts of Bengal, where it attains two feet in length : as I have not seen it, I must refer the reader to Buchanan's description.

### IV.—CYPRINUS ANGRA, Buch.

Hardwicke's Illust. t. 86, f. 1. Pisces l. c. t. 3, f. 1.

I had figured and named this species *Gobio leprosus* during my journey in Assam, before I became acquainted either with the figure in Hardwicke, or aware of the existence of Buchanan's unpublished drawings ; but I have since lost the specimen I had collected on the occasion, and must now trust to my original notes for a description of it. The length of the head to that of the body is as one to four ; operculum rounded behind ; mouth small, directed obliquely upwards ; snout prominent and fleshy, with two small cirri at the corners of the mouth ; suborbital plates broader below than behind the eyes ; pectorals small, with their bases slightly covered by the branchial plates. The fin rays are,

D.10: P.10: V.9: A.8: C.19.

There are thirty-five scales along the lateral line, and fourteen in an oblique row from the base of the ventrals to the dorsum. Colour pale olive brown above, and reddish-white below. Intestines long, dark coloured, and convoluted in circles round the parieties of the abdomen. Posterior cell of the air vessel much larger than the anterior.

It was found by Buchanan in the Bramaputra, and there it also occurred to me. The only part of the figure in Hardwicke to be relied on is the outline, and even that is so obscured with a fanciful display of colours that no one, unless familiar with the species, could detect its resemblance to the drawing.\*

V.—GOBIO LISSORHYNCHUS, J. M.

t. 55, f. 5.

This species includes those varieties, as far as I am able to make them out, referred to in the *Gangetic Fishes* under the names of *Cyprinus cura*, *Cyprinus acra*, and *Cyprinus bata*, and which are distinguished by hard smooth lips, snout without cirri, and with from eleven to twelve rays in the dorsal fin. In the preceding part of this paper, in which I have given an outline of the species and groups composing the family generally, I have been anxious to keep distinct all species which we have any good authority for supposing really to exist in India, in hopes that further information will be obtained regarding them.

Buchanan distinguished *Cyprinus bata* chiefly by the upper lobe of the caudal fin, which he says is longer than the lower ; but in the drawing he has left us,

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\* During the twenty years Buchanan's drawings lay at the Botanic Garden before they were transferred to Hardwicke's Illustrations, many of the colours appear to have undergone a change, such as light blues and greens becoming dark brown ; not aware of this, the copyist has not only imitated the altered colours, but added a little to their intensity ; the consequence of which is, that both this and the other figures similarly obtained in the expensive work referred to, are made to appear in black, where they should only be pale grey or green.

there is scarcely any perceptible difference between the lobes of the caudal, otherwise we might suppose my *G. anisurus* to be his *Cyprinus bata*; but it is to be remarked that in my species the lower, and not the upper lobe is the longer of the two. *Cyprinus acra*, Buch. is also said to have the upper lobe of the caudal longer than the lower, but it has only eleven rays in the fin of the back; now, whether a species can be said to have eleven or twelve rays in the dorsal, depends entirely on the degree to which the last ray is separated or divided, which in this group it always is, more or less; there can therefore be little doubt that *Cyprinus bata* and *Cyprinus acra* are the same species. *Cyprinus cura*, Buch. is said to differ from each of the former two in the lobes of the caudal being equal, and by there being only seven rays in the anal, while each of the other fins has eight; but what has been said with regard to the division of the last ray of the dorsal, applies also to that of the anal fin, which also in this group is always divided; and according to the degree in which it is separated, the fin may be said to have one ray more or less. I therefore treat these three varieties as one species, which I have named *G. lissorhynchus*. Before entering on the description of this species, I must be allowed to mention one peculiarity which it possesses in common with *G. isurus* and *G. limnophilus*, namely, that there is a slight prominence on the symphysis of the lower, and a corresponding fissure in the intermaxillaries of the upper jaw, but the lower jaw is always round in front, and shorter than the upper, which prevents the character just noted from being confounded with an analogous prominence on the apex of the lower jaw in *Sarcoborinæ*, in which sub-family that organ is always narrow and pointed at the apex.

The head is compressed, and equal to about a third of the length of the body, exclusive of the head and caudal fin; the snout is hard, deep, prominent, and smooth, without cirri. The eyes are placed anterior to the middle of the head; the posterior margin of the operculum is broad and somewhat square, or, unequally rounded. The body is symmetrical, equally arched above and

below ; dorsal and ventrals are opposite. The lobes of the caudal are equal in length. The fin rays are,

D.11 or 12: P.16: V.9: A.7 or 8: C.19.

There are thirty-nine scales along the lateral line, and thirteen from the base of the ventrals to the dorsum.

The liver is situated in the anterior part of the abdomen, immediately behind the diaphragm as usual, in conjunction with the stomach ; the alimentary canal and stomach form a long and narrow tube, equal to eight or nine lengths of the body. The usual size which this species attains is from four to twelve inches in length, it is found in all the fresh waters throughout Bengal and Assam.

#### VI.—GOBIO ISURUS,\* J. M.

This species bears so striking a resemblance to the figure Buchanan has given of *Cyprinus ariza*, that I have thought it unnecessary to attempt a better representation of it, although there is no reason to suppose it to be the *Cyprinus ariza* which Buchanan has described ; on the contrary, it appears to me to be quite distinct from that species, in which the snout is rough, soft, and perforated by numerous mucous pores, while in this it is smooth, hard, and without pores. It corresponds with *G. limnophilus* in the number of its scales, but in that species there is a distinct tube passing along the middle of every scale on the body, as well as on that row which forms the lateral line, and to which such tubulated scales are usually confined ; so that *Gobio limnophilus* has as many lateral lines as there are rows of scales on the sides, while in this species the tubulated scales are confined to the lateral line alone.

The length of the head is equal to two-thirds of the depth of the body, and a fourth of its length ; the scales are large, and disposed in rows, of which there

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\* See Buchanan's figure of *Cyprinus ariza*, Journ. Mysore, vol. iii. t. 31.

are fourteen between the ventrals and dorsum on either side, and thirty-seven disposed along the lateral line. The fin rays are,

$$D.11 : P.14 : V.9 : A.7 : C.\frac{10}{7}.$$

The colour above is bluish grey, diminishing in intensity on the sides; the scales are long, and soft, presenting on the upper parts of the body pentagonal exposed faces.

The length of the intestinal canal is equal to eleven lengths of the body, including the head and caudal fin, and the whole canal is a simple continuation of the stomach, which differs from the rest of the tube merely in being wider at the anterior extremity. The liver consists of small detached glands dispersed throughout the folds of the intestines, as already described. The only specimens I have seen of this interesting species were found by Mr. Griffith at Suddyah, in Upper Assam. It seems to be confined to the higher parts of the valley where the large rivers fall in rapid currents from the skirts of the mountains, and the water is clear, and the bottom rocky. In such situations I learn from Mr. Griffith that it associates with *Gonorrhynchus*, *Gobio anisurus*, and *Cyprinus semiplotus*.

#### VII.—*Gobio liminophilus*, J. M.

t. 55, f. 3, and t. 58. f. 2.  $\beta$ .

This is one of the commonest species in all parts of Bengal, particularly delighting in swamps and ponds, but also common in large rivers where the water is fresh and the currents slow. After my figure had been lithographed, I found a better one in Buchanan's collection named *Cyprinus bangon*, which I suppose to represent a larger individual of the same species, but this has yet to be ascertained, since we find that figures without dissections shewing the structure of parts, are not to be relied upon in this group.

The general proportions, particularly in regard to depth vary a little. The head is equal to about one-fourth part of the length of the body, exclusive of



the head and caudal ; the colours of the back as well as of the caudal and dorsal fins are usually grey : the lower parts as well as adjacent fins are greyish white, with a yellowish tinge often at the base of the fins as well as on the under jaw. The caudal and dorsal fins, together with some of the scales are often tipped with a darker grey ; the lips and snout are thin and hard, the latter is however prominent. The fins are small and feeble, and the dorsal may be said to contain either eleven or ten rays, according as the last may be more or less divided, and the first, which is usually nothing more than a small point situated close to the root of the second, may happen to be more or less developed, but the rays may generally be stated as,

D.10 : P.19 : V.9 : A.7 : C.19.

The alimentary canal is a small but lengthy tube, equal to above eight lengths of the entire fish including the head and caudal ; the liver is disposed in several detached glands, as in the last described species. There are thirty-six scales along the lateral line, and about twelve rows from the base of the ventrals to the dorsum ; the scales are long, and on each there is a tube extending from the base towards the apex for the transmission of mucous to the surface of the body, the same as the tube forming the lateral line, but smaller ; and as these tubes are connected with a glandular structure beneath the scales, the latter consequently adhere more firmly to the body than they do in other species. After a specimen has been kept in spirits for a time, and then exposed to the air until it becomes dry, the scales will be found to present a succession of depressions extending along the middle of each row, caused by the contraction of the mucous ducts which draw the middle of the scales inward, by observing which the peculiarity of this species may be detected. Even in the living state this peculiarity may be observed.

VIII.—*Gobio bicolor*, J. M.

t. 40, f. 1.

The general form and proportions of this species agree very nearly with those of *Gobio isurus*, but in structure it differs essentially from that species. The snout is depressed, smooth, long, soft, and rather pointed; with a few mucous pores, which however cause little or no roughness. The mouth is small and semicircular, and placed horizontally on the lower surface of the head, which is equal to a third length of the body, exclusive of the head and caudal. The eyes are placed on a prominent ridge intermediate between the snout and the branchial aperture. The depth of the body is equal to half the length, exclusive of the head and caudal; the fins are feeble, the pectorals and ventrals about equal in size, and the upper lobe of the caudal is rather longer than the lower; the upper part of the body from the lateral line to the dorsum is a dark blue, the lower parts are white. The fin rays are,

 $D.12 : P.17 : V.9 : A.7 : C.12.$ 

There are forty-two scales along the lateral line, and thirteen in an oblique row from the base of the ventrals to the dorsum; the scales are short, and their exposed surfaces are rhomboidal as usual. The alimentary canal is equal to eleven lengths of the body inclusive of the head and caudal; and as in the last two species, the liver consists of numerous detached glands dispersed throughout the abdomen.

This species was found by Mr. Griffith (to whom I am indebted for the only specimen I have seen) to inhabit the higher parts of the Bramaputra, where the river becomes rapid and clear, and the bottom composed of boulders.

IX.—*Gobio anisurus*, J. M.

t. 40, f. 2.

This is a small species of which I have only seen one individual, which was found by Mr. Griffith in the higher parts of the Bramaputra.

The length of the head is equal to the altitude of the body, and in proportion to the length of the latter as one to three. The head is a little more compressed than the body, and deep, especially at the snout, which is rough and porous, as well as muscular and prominent. The mouth is small, the lips thick, hard, and smooth without cirri. There are about forty-three scales along the lateral line, and the lower lobe of the caudal is longer than the upper. The fin rays are,

$$D.12 : P.17 : V.9 : A.7 : C.\frac{9}{10}$$

The colour above is dark bluish, softened off on the sides to the lateral line, below which it is white. The scales are lanceolate at the apex, and their structure is nearly uniform at both extremities.

The intestines are of great length, equal at least to those of *G. isurus*; the liver is very obscurely developed, and distributed in minute detached lobes in various parts of the abdomen. ●

X.—CYPRINUS BOGA, Buch. P. G. t. 28, f. 80.

*Cyprinus ariza*, id. *Cyprinus pangusia*, id.

The two first are chiefly distinguished from each other by the structure of the lower lip. Of *Cyprinus boga*, Buchanan in one place says, *labeo inferiore crenato*,\* and in another, that the under lip is *indented* on the edge.† Of *Cyprinus ariza* he says in one place, *labeo inferiore reflexo, integerrimo; rostro lævi*; in another place he observes of the same species, that the under lip is reflected on the edge, and omits any allusion to a peculiarity of the nose, further than that it is supplied with large pores, but he also remarks this of *Cyprinus boga*. Were I to detail the attempts I have made to distinguish these two species with all the fishes of Bengal that I have been able to

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\* *Pisc. Gang.* 386.

† *Op. Cit.* 286.

collect in four years before me, I should only contribute to the embarrassment of the question. With regard to the third species, *Cyprinus pangusia*, which according to Buchanan is distinguished by fourteen rays in the dorsal fin, while in each of the former varieties that fin contains only twelve rays, it certainly does appear at first sight to rest on a better footing ; especially as all the species of this group that are without cirri, present a hard prominent snout, and have only twelve rays in the dorsal. I am acquainted however with a variety which for a long time I considered to be *Cyprinus pangusia*, but on re-examination I found two rudimental cirri, and that the rays of the dorsal fin are strictly fifteen, thus making it correspond with the *Rewah*, a variety of *Cyprinus mrigala*.

When we add to these observations the testimony of Buchanan himself, that the three species nearly resemble each other, and compare the striking resemblance that exists between the figure of *Cyprinus boga*, *Pisc. Gang.* t. 28, f. 80, and *Cyprinus pangusia*, t. 42, f. 1, we cannot hesitate in the present state of the question to regard them as one and the same species. Still, however, we ought not to forget the distinctions Buchanan has pointed out, and which have been preserved in the synopsis. The following variety may however be distinct from *Cyprinus boga*, and the drawing of it in Buchanan's collection is marked *Cyprinus pangusia*, although I consider it to be the fish he has described as *Cyprinus ariza*.

CYPRINUS PANGUSIA, Buch.

t. 42, f. 1.  $\beta$ .

The length of the head is equal to the depth of the body, and to a third of the length, exclusive of the head and caudal.

The head is compressed rather more than the body, so as to render it narrow between the eyes. The snout is narrow, but rough, porous, prominent, and soft, without being loose or pendulous ; the under jaw is short and thin, so as to be in a great measure concealed by the snout when the mouth is

closed. The colours above are dark olive green or blue, below white; the pectorals and ventrals are of equal size; the caudal is more divided than that of *Cyp. boga*, Buch. Intestines and stomach form a canal of great length. The fin rays are,

D.12: P.16: V.9: A.7: C.19.

There are forty-three scales along the lateral line, and about fifteen from the base of the ventrals to the dorsum.

XI.—GOBIO RICNORHYNCHUS, J. M.

t. 55, f. 1.

This species I am inclined to think is identical with that which is figured in Hardwicke's Illustrations under the name of *Cyprinus falcata*, although if the figure is to be depended on, (and it is large enough for any purpose) the dorsal would seem to contain thirteen, and the anal eight rays. In Assam I was familiar with a fish which I have since lost from my collection, called *Nepura* by the fishermen, which I considered to be the one figured by Hardwicke. In this opinion I was farther confirmed by a sketch of the same fish which Mr. Griffith had made. Still as a specimen of the Assam fish is wanting, and no description of Hardwicke's figure that I am aware of published, I think it safer to keep the two apart until they are proved to be the same. In the latter case the best of the three names proposed may be selected, or the one applied to Hardwicke's figure by Mr. Gray retained. Should it prove to be a *Gobio* rather than a *Labeo*, either *ricnorhynchus* or *malacostomus*, as proposed in the synopsis, would be equally applicable to it, as the only species in the group with a wrinkled snout and soft pendulous lips. The contents of the abdomen were removed from the only specimen I have seen, and in deciding as to whether it be a *Labeo* or a *Gobio*, perfect specimens ought to be examined.

The length of the head to that of the body is as one to four, the back is arched gradually from the snout to the dorsal, ventral margin nearly straight, depth about a third of the length, forty-three scales along the lateral line, and fourteen in an oblique row from the base of the ventrals to the dorsum. The head is thick and fleshy ; the eyes small, and the lips loose and pendulous. The pectorals and ventrals are of about equal size. The fin rays are,

D.12 : P.17 : V.9 : A.7 : C.19.

The colour above is dark olive-brown, below yellowish white. The snout is perforated with numerous large mucous pores, and intersected by many deep wrinkles. The specimen here described was found by Mr. Hodgson, by whom it was presented to the Asiatic Society. The *Nepura* of the Assamese I found as low as Bishenath, where the current is slow, and the bottom sandy ; here its colour is deep blue on the back. It is small, and very rarely met with in Lower Assam ; but above the rapids Mr. Griffith says it is very common, and attains a large size, and that the fins and tail are dusky, the body below white, above olive-green. He also observes that it refuses all kinds of bait and flies, although like *Catostomus dyocheilus*, with which it associates, it is frequently seen plunging on the surface.

*Remarks on the Genus.*

The striking peculiarity of this group consists in the great length of the alimentary canal, and uniformly herbivorous habits of nearly all the species. Their short and feeble fins adapt them to such waters as contain the greatest abundance of plants, from which alone they derive their food. In the numerous dissections I have made of them, *Cyprinus mrigala* is the only one in which I found a trace of any animal remains in the intestines or stomach. Except the last species described, they are confined chiefly to jeels and ponds, but they are also found in the large rivers where the currents are slow ; but they never, I believe, descend with the rivers to within the influence of

salt-water. They are all used as a wholesome food by the people of India ; few of them however attain any very great size, or are much esteemed for their flavour by the wealthy. There is reason, I must observe, to believe that the quality of their flesh varies occasionally according to the ponds from which they are taken.

As they do not prey upon each other, the size of the water into which they are introduced is the only limit to the extent to which they will propagate, provided merely that the *Siluridæ* and similar carnivorous kinds be not allowed to flourish in the same ponds. If the proprietors of tanks were only to allow their fishermen to take the destructive kinds from their ponds for a season or two, such as the various kinds of *Magur*, *Pabda*, *Singhi*, *Boalis*, *Aoar*, *Sal*, &c. they would then find the *Mrigala* and other Bangons so numerous, as to repay the little attention required to prevent their destruction. In Bengal fishes are so abundant that perhaps any great augmentation of their numbers is little to be desired ; but in the North-western Provinces the case is very different, especially where there are few tanks and streams ; and these I have found to be almost entirely abandoned to Pikes and other rapacious species, such as cannot allow the more profitable kinds to multiply, where, from a scarcity of water they ought to be preserved with the greatest care. When fishes are too much crowded in ponds, they are liable to epidemics. In June last, Mr. James Prinsep sent to me a number of Bangons from a pond at the Mint, in which they had become blind, some of one, and others of both eyes. Mr. Prinsep insisted on investigation of the subject, and with the aid of our friend Mr. J. W. Grant, we found the disease to be a dropsical affection of the membranes of the eye, by which an excess of fluid was secreted so as to cause that organ to protrude beyond the orbits, in some cases almost to the size of an egg. The fishes thus affected were all of the same species, *Gobio limnophilus*, and all in the pond were observed to be seized in the same way. The cause of this singular disease was of course less

obvious than its nature ; whether Mr. Prinsep found any peculiarity in the water to account for it or not, I never heard ; and although the circumstance is curious, I mention it chiefly as an instance of Mr. Prinsep's vigilance regarding every thing of interest, however trivial to ordinary observers.

#### V.—GEN. GONORHYNCHUS.

This genus was formed by the elder Gronovius, author of various memoirs on fishes during the middle of the last century, from a single species found at the Cape of Good Hope ; and though no increase to the number of species has since been made, I find that we have no fewer than eight in India, many of which were described by Buchanan under the sub-generic name *Garra*, in his ninth division of the Cyprins.

Their very remarkable appearance and peculiar habits, pointed them out to Buchanan as a distinct group, but it is not easy to account for Buchanan, as well as all subsequent writers, overlooking their affinity to the Cape fish described by Gronovius. Buchanan observed them to live amongst rocks and stones in rapid mountain torrents and rivers with pure sandy bottoms, on which account some of them are called by the natives *Balitora*, or sand-diggers ; the word *Garra* also refers to the same habit.

The head is long, and covered with a thick integument so as to conceal the branchial rays and opercular plates. The eyes are small, and placed rather more backward than the middle of the head ; the mouth is small, transverse, and situated in the lower surface of the head, and is opened and closed by means of the muscular structure of the snout, which projects considerably in front ; the dorsal and anal fins are small and without spines, the former placed opposite to the ventrals. The vent is situated immediately behind the ventral fins, and not at the front of the anal as in the Gudgeons. The liver is very small, and occupies the front part of the abdominal cavity except in *G. gobioides*, in which, as in some of the Gudgeons, it is either altogether absent, or dispersed



in small scattered glands throughout the folds of the intestines, which usually float in a copious oily secretion.

The Cape species, *G. vulgaris*, Gm. the only one hitherto known, has elongated opercula and branchial membranes; still, from the description given of it by authors, I conceive our Indian species to belong to the same group, although they have short branchial apertures and rays, and are capable of sustaining life for a considerable time out of water. Those I have examined are without a tongue, and the *os. hyoides* enters into the formation of the lower jaw, being prolonged in front between its two lateral limbs which are placed parallel to each other, and united anteriorly by dense fibrous ligaments; these limbs are short, and articulated behind so as to admit of very limited motion in the jaw, which thus resembles a valve, bounded in front by the long projecting snout.

The manner of feeding, for which this structure is intended, has been described in detail in an account of one of the most characteristic species, *G. petrophilus*, J. M. an inhabitant of high alpine streams.\* This species subsists on a slimy vegetable production derived from the surface of rocks and stones in clear mountain torrents by swimming with sufficient force over the surface on which the substance grows to uproot it by means of the depressed lower jaw, which is formed for this purpose alone.

It is not yet determined whether all the species have the same habits, as they have not been watched with sufficient care; but as they are always found in clear mountain streams on rocky bottoms, or in the larger rivers along the skirts of mountains, it is probable they all agree more or less in their mode of procuring food.

In the extraordinary length of their abdominal canal, they are only, if at all, surpassed by the Gudgeons, and the entire tube is filled with a green slimy substance, consisting no doubt of confervoid plants.

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\* Jour. As. Soc. Beng. Vol. iv, p. 39, where it is named Kemaon trout.

Some of the Gudgeons might from the situation of the mouth be described as Gonorhynchs; the latter differ from the former chiefly in having the lower jaw formed for uprooting a scanty food derived from plants that are fixed, rather than for merely collecting such as are loose and floating plentifully throughout the waters they inhabit. The two groups have therefore the nearest affinities to each other, the nature of the food, and the structure of the digestive organs being nearly the same in both. The difference between them arises rather from the circumstances in which they are respectively placed, than from any thing peculiar to the nature of either, that the other does not possess; and may be traced perhaps to an easy existence on the one hand, in the still waters of ponds and lakes, amidst abundance of food derived from loose, floating vegetation; and, on the other, to the precarious struggle for life in mountain torrents, liable to sudden and violent floods, which as suddenly subside. These conditions seem to allow of the weak jaws, clumsy bodies, and feeble fins of the Gudgeons; and to require in the Gonorhynchs a structure more adapted to battle against the difficulties of their situation in the cold rocky streams of high altitudes, where aquatic vegetation is scanty, and only to be obtained by force from the slippery surface of boulders, and water-worn rocks. The most remarkable character which belongs to the group, is a circular disk or sucker, which is placed on the lower surface of the head, behind the lower jaw. This is no doubt used in cases of difficulty for adhering to rocks, and thus resisting the violence of mountain torrents which, without such a contrivance they would be unable to withstand. This character, no less than the inferior position and structure of the mouth, seems to indicate a relation with the *Palatycara*, Lampreys, and *Cyclopterus*. Their fins are strong, but not large, and the rays are soft, and often enclosed in a thick membrane: their bodies are elongated, by which they are rendered more manageable in rapid currents, while the peculiar structure of the lower jaw affords an instrument singularly adapted for obtaining the only food procurable in the rocky basins to which they are confined. These

peculiarities, although perhaps more remarkably developed in this than in any other group, do not alone belong to the Gonorhynchs, but are in some degree shared by the no less remarkable group *Oreinus*. Both seem to possess in the highest degree a structure that should enable them to survive in situations where the proper element of fishes is most disturbed, and most exempt from the extraneous objects which constitute the ordinary food of their class. Whether any other kind of fishes may yet be found in still higher altitudes than those at which the Gonorhynchs and Mountain Barbels disappear, is a problem in the distribution of this class of animals, that travellers in the Himalaya, and other lofty regions must decide. In the limpid streams which Mr. Griffith passed with Captain Pemberton, at elevations of from six to eight thousand feet in Boutan, no inhabitants were found; and both here and at Simla, as well as in Kemaon, the Gonorhynchs and Mountain Barbels have not been found at greater altitudes than six thousand feet above the level of the sea, where we may presume they disappear; but from that altitude downwards to the plains, they constitute the prevailing forms that have hitherto been met with in the waters.

I.—GONORHYNCHUS GOBIOIDES, J. M.

t. 43. f. 1.

*Herilwa* of the Assamese.

This is the shortest and most robust species of the group, and corresponds in its figure considerably with the Gudgeons. It is probably the species named *Cyprinus mosario* by Buchanan, but as that author has not left a figure of the species he alluded to, or any other description than merely the number of the fin rays, and the absence of cirri, his name could only be adopted with doubt.

The length of the head is equal to the altitude of the body, and in proportion to its length as one to four. The back and lower margin are equally arched, and the head is prolonged in front of the mouth, where it terminates in a soft fleshy snout. The lower surface of the head is flat, containing the

## III.—GONORHYNCHUS MACROSOMUS, J. M.

t. 43, f. 7.  $\beta$ *Cyprinus latius*,\* Buch.

This species appears to be very widely distributed, having been found by Buchanan in the Tista river, at the foot of the Sekim mountains on the northern frontier of Bengal, and by Mr. Griffith in the cataracts of the Brahamputra, in the eastern extremity of Assam. A small collection of fishes made by Captain Hannay in the rapids of various rivers in Assam, also contained many examples of this species. The length of the head is equal to the altitude of the body, and to one-sixth part of the entire length. The eyes are placed somewhat behind the middle of the head, and two short cirri are placed at either side of the snout, which is long, round, and muscular; the anterior lip is fimbriated on the edge, the posterior lip smooth, the mouth small, and transverse. Thirty-nine scales are placed along the lateral line, and ten in an oblique row from the base of the ventrals to the dorsum. The fin rays are long, and in number as follows,

D.11 : P.14 : V.8 : A.7 : C.19.

The two first rays of the anal are closely united. The general colour is dusky greenish blue, diminishing in intensity on the sides, belly, and fins. The three species above described are the largest of the group, usually attaining six or eight inches in length.

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\* By giving a Latin termination to *Lati*, the native name of this species, Buchanan has rendered it the most inappropriate that could be invented. So far from it being broad, it is the longest proportioned form among the *Pænominae*, and is in fact a true representative of the anguilliform fishes.

## IV.—GONORHYNCHUS BREVIS, J. M.

t. 43, f. 6. β.

*Cyprinus gohama*, Buch. *Cyprinus dyangra*. id. Coll.

This species I have not met with, but it has been found by Buchanan in the Kosi river, in the north-western parts of Bengal, as well as in the Ganges. It appears to differ from the former in being of shorter proportions, and by having one ray more in the anal fin, which with the ventrals and pectorals are thin and pelucid; only that Buchanan states that it contains two cirri, his description might be referred to *G. gobioides*.

In his collection of figures, however, Buchanan seems clearly enough to point out the species to which he alludes in his description, although he has there given it a different name.

## V.—GONORHYNCHUS RUPECULUS, J. M.

t. 43. f. 4. 5.

This species has the under surface of the head flat, with a cartilaginous disk or sucker behind the mouth; snout broad, smooth, depressed, with a row of open pores extending round the snout between the nostrils, and another row between the eyes; mouth very small, vertical, and fleshy; pectorals round; fin rays short, soft, and the membrane in which they are enveloped thick and opaque.

D.8 : P.10 : V.9 : A.6 : C.20.

Colour yellowish white below, and dark brown above, without spots. Thirty-five scales along the lateral line, and nine rows on either side between the dorsal and ventrals. The specimen from which this description has been taken was found by Mr. Griffith in the Lacheh river a few miles beyond Bramacund, at an elevation of 1000 feet in the Mishmee mountains, lat. 27° 45' N. long. 96° 20' E. The abdominal canal is very narrow, and about eight lengths of the body.

With it was found the following, which though I have described as a species, may only prove to be a variety.

VI.—GONORHYNCHUS BRACHYPTERUS, J. M.

Under surface of the head flat, with a cartilaginous disk behind the mouth; two very minute cirri and a few irregular pores on the snout; there are thirty-six scales along the lateral line, and seven rows between the ventrals and dorsal on either side.

D.8 : P.14 : V.9 : A.7 or 6 : C.19.

The disk or sucker is, as usual in all the species in which it is fully developed, of an oval form; composed of cartilage slightly elevated in the middle, but hollow externally, and surrounded with a loose membranous margin.

VII.—GONORHYNCHUS BIMACULATUS, J. M.

t. 43, f. 2.  $\beta$

This species, which is figured in Buchanan's collection under the name of *Cyprinus godiyava*, is, I conceive, the one described in the Gangetic Fishes as *Cyprinus lamta*, which was found by Buchanan in rivulets with rocky bottoms in the province of Behar, as well as in the Gorrockpore district. In a small collection of fishes presented to the Asiatic Society by Mr. Hodgson of Nipal, I find a specimen which seems to correspond equally with the figure and description given by Buchanan. The following is its description—Pectorals rounded, snout with two very minute cirri, rough, divided by a deep fissure, and studded with large irregular pores; behind the mouth there is a smooth callous sucker, and at the base of the caudal fin on either side, a black spot. The fin rays are,

D.10 : P.13 : V.9 : A.7 : C.19.

Thirty-five scales along the lateral line, and seven rows from the base of the ventrals to the dorsum. The following may perhaps be regarded as a different species,

VIII.—GONORHYNCHUS CAUDATUS, J. M.

Snout warty, porous, and divided by a horizontal fissure, without cirri ; a black spot at the base of the caudal ; lower lobe of the caudal longer than the upper ; thirty-four scales along the lateral line, and eight rows from the base of the ventrals to the dorsum. This species, if it may be so called, corresponds in other respects with *G. bimaculatus*. It was found by Mr. Griffith in the Mishmee mountains.

IX.—GONORHYNCHUS FIMBRIATUS, J. M.

t. 43, f. 3.  $\beta$

*Cyprinus sada*, Buch.

This species is distinguished by four cirri shorter than the head, the lateral line is placed high on the sides, and the dorsal fin anterior to the middle of the back. The fin rays are,

D.13 : P.— : V.9 : A.7 : C.

Colour green above, and silvery below. This would seem to be an alpine form although it wants the sub-maxillary sucker, and was found by Buchanan in the Bramaputra in Lower Assam. I have not met with it, and can therefore add nothing to the information given regarding it in the Gangetic Fishes.

To this group must also be added *Cyprinus gatyla*, Gray, Hardwicke's Illustrations, t. 5, f. 3, said to have been found in the mountains of India. In the synopsis I have stated what seem to be its distinguishing characters. Since the paper has gone thus far through the press, the first volume of Mr. Swainson's work on the Natural History of Fishes, Amphibians, and Reptiles,

Lond. 1838, has reached me, and affords many observations in corroboration of the results to which I have been led in the analysis of Indian *Cyprinidæ*, particularly in the formation of the aberrant groups of the family. Speaking of the apodal order, to which the *Gonorhynchus* present many relations, as well in their lengthened cylindric forms, thick integuments, and submaxillary sucker with which they are furnished, Mr. Swainson says, "it would seem, indeed, that nature upon leaving the annulose circle, and entering that of the fish, intended to show us all the forms of variation in the first group, which she afterwards employs to characterise higher divisions: this she has done in the class *Acrita*, as Mr. Macleay has so beautifully illustrated in the "*Horæ Entomologicæ*;" and in confirmation of this, we now find the apodal forms reappear, not alone among the *Pæonominæ* as in the *Gonorhynchus*, but also in the *Platycaura* and *Cobitina*, thus marking the most distant groups with certain types, through which the character of annulose animals, or worms, may be traced. Unacquainted before with this analogy, yet in the formation of aberrant groups I have been led to the development of its truth by another path, than the one which led to its detection by Mr. Swainson.

## II.—SUB-FAM.—SARCOBORINÆ, J. M.

CHARACTERS.—*A blunt knob on the apex of the lower jaw, more or less distinct; intestinal canal short; colours bright. Like the Pæonominæ, they are confined to fresh water, but their habits are carnivorous; size small. Three rays in the branchial membrane.*

The first object is to show that the relations of this sub-family to the *Pæonominæ* are parallel, and therefore that the two groups are distinct. The number of types representing genera in each sub-family are apparently five, some of them are very well made out; as for instance, *Cirrhinus*, *Barbus*, *Gobio*, and *Gonorhynchus* among the *Pæonominæ*; and *Systomus*, *Perilampus*,



*Leuciscus* and *Opsarius* among the *Sarcoborinæ*. It remains, however, to be determined from the materials of other parts of the world, whether the *Catastomi* and *Labes* may not be united with the *Cirrhini*, and *Cyprinus carpio* with the Barbels, or retained as the type of distinct groups to which *Cyprinus semiplotus*, J. M. and other similar species may be united. It remains in like manner to be determined, whether the Breams are to be placed with the *Pænominae*, or, as the only Indian species indicates, with the *Sarcoborinæ*; and in the latter case, if they may not be united in one group with the *Perilamps*.

It is these doubts, which can only be settled by a direct appeal to the species of other countries, that renders a comparison of the two groups in this place somewhat unsatisfactory. Without attempting to speculate on the subject, we may at once compare together those genera in both sub-families with which we are best acquainted.

The head and body in the genus *Barbus* are long, and slender, but in the genus *Systomus* short and deep: the Barbels blend in their direct affinities with the herbivorous forms; and the *Systoms* with the carnivorous. The same result will attend the comparison of any of the other groups of the two sub-families, as the *Opsarions* and Barbels: both have the body and head long and slender, and are the most carnivorous in their respective groups; both have short dorsal fins, and the head much elongated behind the eyes; but here their relations end. The Barbels are without an armature on the jaws, and have a long, narrow stomach and intestinal canal, and feed upon small fishes and plants: the *Opsarions*, on the other hand, have a capacious fleshy stomach, an armature on the lower jaw, and the power of seizing and swallowing piecemeal species wonderfully approaching their own size. In the one case the characters blend with the herbivorous, in the other with the carnivorous *Cyprins*; thus proving such relations as do exist to be those of analogy, and not of affinity. The affinities of the Barbels are indeed well understood to be confined to the *Pænominae*. The direct affinities of the *Opsarions* with

the Perilamps and Leuciscs are, on the other hand, clearly enough confined to *Sarcoborinæ*; but there is a group still required to fill up the space between the Opsarions and the *Apalopterinae* in order to complete the *Sarcoborinæ*, and unite that group with the aberrant circle. Whether the American genus *Amia*, or the genus *Sudis*, Cuv., or *Erythrinus*, Gronov. which all naturalists suppose to present near relations to *Cyprinidæ*, may, one or all, be destined to fill up this blank, is a question regarding which, without those genera before me, I cannot venture an opinion. *Amia*, I may remark, is said to be without cæcal appendages to the stomach, a circumstance which ought to place it with the Cyprins, rather than with the *Clupeidæ*.

It may be necessary to explain in this place why I have given the two principal groups of *Cyprinidæ* the rank of sub-families, rather than that of mere genera. A genus appears to have been intended as the lowest denomination of a perfect group; and, indeed, is still so regarded that no smaller groups are supposed to be comprised within it, although where the species are numerous they may be conveniently separated into artificial sections, or sub-genera. Should such sections be further augmented, so as to become necessary to separate them still farther, it is obvious that this can only be done by augmenting the value of the higher group, by raising it to the rank of a family, or sub-family, when the sub-genus would naturally become a genus. This is what I have done; and though a species may be so isolated, as to form a distinct family of itself, by means of the numerous links that would be requisite to connect it with the nearest known forms being lost, or undiscovered, yet this is so unlikely now to be the case in zoology, that we may regard the number of genera as the safest rule for determining the value of groups; and as genera are understood to be the lowest denomination of perfect groups, and sub-genera mere artificial sections of genera, we can have no uncertainty in the nomenclature of groups; though I am aware that for want of a little reflection on this subject, the distinction between genus and sub-genus is often confounded, or ill understood.

This sub-family includes the several divisions into which Indian species have been separated by Buchanan, under the terms *Chela*, *Barilius*, *Puntius*, *Danio*, *Marulius*, and *Cabdio*, which were merely characterised by that author as having no resemblance to other genera. Indeed it would have been impossible in Buchanan's time to have assigned positive characters by which the *Sarcoborinæ*, or their subordinate groups, could be distinguished, without a knowledge of the discoveries that have been made by Mr. Macleay. In the introduction to the *Gangetic Fishes*, we are told that to have adopted the improvements introduced by Cuvier, whose system appeared after the M.S. had been prepared for the press, would have occasioned a trouble for which there would not have been a sufficient counterbalance; and indeed that system alone, without the aid of Mr. Macleay's views, which appeared about the same time, would have afforded very little assistance in this family. It is impossible, however, not to admire the excellent notions of natural affinities which are apparent in every part of Buchanan's work, but particularly in the genus *Cyprinus*, where he was induced to cast aside all respect for systematic writers, and to act independently of their authority. All that can be regretted is, that more care had not been bestowed by him in characterising the new groups which he proposed, of which *Chela* alone appears to be the only one that has been adopted, and that merely from a supposed affinity which it presents to *Clupea* or Herrings. The *Chelæ*, however, strictly speaking, consist only of three or four aberrant forms, whose affinities lie between the Perilamps and Opsarions.

#### I.—GEN. SYSTOMUS, J. M.

The head is small, oval, and smooth; the mouth is small, and when opened the intermaxillaries are drawn forward so as to form a somewhat cylindrical tube; the tongue is thick and fleshy; the dorsal, placed in the middle of the back, is composed of rather long, but not numerous rays preceded by a spine, and placed opposite to the ventrals; the body is deep, short, compressed, and

salient on the upper margin, but less prominent below; the colours are usually distributed in peculiar spots and streaks; the scales are large. The species are numerous, and of small size, but very abundantly distributed throughout the ponds of Bengal, Assam, and indeed the waters of all parts of India.

The stomach is a long, narrow, fleshy tube, terminating in a single intestine, which in most of the species is twisted round the stomach like the thread of a screw, see Pl. 54. f. 12. *a*, œsophagus, *b*, is the vent. The entire length of the canal does not however in any case exceed thrice that of the body. The air-vessel and liver are fully developed, and present slight variations of form in the different species, but agree generally with the same organs in the Cirrhins. From the shortness of the intestinal tube compared with that of *Pænomina*, as well as on account of their bright colours, and the peculiarities of the mouth, which seems to be constructed chiefly for insect food—the remains of this having been found abundantly in their stomach—these fishes are placed with the *Sarcoborinæ*. Their protractile jaws, often supplied with cirri or muscular filaments, and their comparatively elaborate digestive organs, indicate, on the other hand, a perfection of structure compared with the other genera of *Sarcoborinæ*, that naturally raises them to the first place in that sub-family, of which they consequently become the typical group.

#### I.—SYSTEMUS IMMACULATUS, J. M.

Pl. 44. f. 5.

Entire length equal to about twice the depth, back arched equally from the snout to the dorsal fin; the upper half of the dorsal spine serrated behind; thirty-two scales along the lateral line, and ten in an oblique line from the base of the ventrals to the dorsum. Four small cirri. The fin rays are,

D.11 : P.15 : V.9 : A.7 : C.19.

Colour green above, below greenish white, fins pale, and a tinge of red on the opercula. The stomach widens at the œsophageal extremity, and the

posterior cell of the air-vessel terminates in a sharp point. *Systomus chrysosomus* of the synopsis is probably a variety only of this species, which is generally distributed throughout the rivers and ponds of all parts of India, sometimes weighing as much as two pounds, but generally much smaller ; it is however taken in vast abundance in some places, which makes up for its deficiency in size ; it is considered a sweet, wholesome food.

II.—*SYSTOMUS CHRYSOPTERUS*, J. M.

A short, well formed little species with red pectoral and ventral fins, without cirri or spots ; each operculum tinged with red ; upper parts of the body olive green, below silvery. The fin rays are,

D.9 : P.13 : V.9 : A.7 : C.18.

Twenty three scales along the lateral line, and eight in an oblique line from the base of the ventrals to the dorsum ; the second ray of the dorsal spinous, but smooth behind. This species would require to be further examined ; it abounds in the Bramaputra in Lower Assam, in the early part of the cold season.

III.—*SYSTOMUS TETRARUPAGUS*, J. M.

t. 44. f. 3.

*Cyp. titius*, Buch. P. G. *Borajalee* of the Assamese.

Depth of the body compared to the entire length, including the head and caudal, as one to three ; body equally arched above and below, a black spot at either end of the lateral line. The fin rays are,

D.10 : P.12 : V.9 : A.7 : C.20.

The stomach is a narrow fleshy tube, ending in a still narrower dark coloured intestine ; which, together with the stomach, is not much above the length of the body.

This is a very common species in the Bramaputra, and is found in great abundance along with the last described.

## IV.—CYPRINUS SOPHORE, Buch.

Op. Cit. t. 19. f. 86.

Without cirri Short and elevated body with large scales, green above, below silvery, with a distinct black spot on the lower part of the dorsal fin, and another at the end of the tail ; and a diffuse yellow spot on the opercula.

D.10 : P.14 : V.9 : A.7 : C.19.

Buchanan states that this species is common in the ponds throughout Bengal. A small collection of fishes forwarded to me by Dr. Macleod, Insp. General of Hospitals, from Hazarcebagh, a place about one thousand feet above the plains, contained examples of this species.

## V.—CYPRINUS TICTO, Buch.

Op. Cit. Pl. 8. f. 87.

Mouth small, without moveable intermaxillaries, lower jaw rather longer than the upper, formed of two limbs placed parallel to each other, and affording a slight prominence at the apex ; intestine twice the length of the body.

The depth of the body is equal to half its length, exclusive of the head and caudal ; scales large, twenty-four on the lateral line, and eight in depth from the base of the dorsal to the ventral on either side. The dorsal is placed on a high and sharp ridge, the arch of the back extending equally from the base of the fin to the snout ; the lower margin of the body is less prominent than the upper ; there is a black spot at either extremity of the lateral line, and one on the dorsal fin ; the first three rays of the dorsal are united, and spiny. Fin rays are,

D.11 : P.15 very small : V.9 : A.7 : C.20.

Colour above dark green or purple, below silvery ; length, about two inches. Though small, this species occurs in such vast numbers as to be extremely important as a wholesome and nutritious article of food ; they are generally taken in casting nets, which at every draught bring up a large number from almost any pond in Bengal and Assam.

A variety of this species with two rows of dots on the dorsal is figured by Buchanan as *Cyp. bimaculatus*, but as it has two black spots on each side, it should rather have been named *quadrimaculatus*.

Buchanan alludes to a species which he named *Cyp. tictis*, the description of which he postponed in hopes of recovering his drawings which were retained in India.

#### VI.—SYSTEMUS PYRROPTERUS, J. M.

Pl. 44. f. 1.

Depth equal to half the length, but the body and head are thinner, or more compressed than in any of the other species ; there is a black spot on the lateral line over the anal fin ; the second ray of the dorsal fin is strong ; mouth furnished with a small hook on the apex of the lower jaw ; twenty-four scales along the lateral line, and nine in an oblique row from the base of the ventrals to the dorsum. The fin rays are,

D.9 : P.12 ; V.9 : A.7 : C.19.

Colour above green, below silvery stained with orange on the sides, fins bright red.

The abdominal canal of this species is thrice the length of the body, exclusive of the head and caudal. It is very numerous in ponds in Upper Assam, seldom attaining a larger size than two inches in length.

## VII.—CYPRINUS CONCHONIUS, Buch.

t. 44. f. 8.  $\beta$ .*Konchon pungti* of the fishermen.

One black spot near the middle of the tail as in *S. pyrropterus*, but the body is shorter and deeper; colour greenish above, and silvery below; fins pale; second ray of the dorsal spinous and serrated behind. The fin rays are,

D.10 : P.10 : V.9 : A.8 : C.19.

In the waters of Behar, Buchanan observes, the fins are blackish in this species, and still farther west in a stagnant river full of weeds it had the belly stained with black, while the dorsal and caudal were yellow, tip with black.

## VIII.—CYPRINUS CHOLA, Buch.

t. 56 f. 3.  $\beta$ .*Chola pungti* of the fishermen.

Depth equal to half the length; arch of the back rising abruptly from the nape to the base of the dorsal; two very small cirri; third ray of the dorsal spinous, but smooth-edged; scales large, twenty-six in a line along each side, and nine in an oblique line from the base of the ventrals to the dorsum. The fin rays are,

D.11 : P.15 : V.9 : A.7 : C.19.

Ventrals bright red, pectorals, anal, and opercula stained red, and an indistinct blackish spot on the tail; above olive green, below silvery.

The alimentary canal is very small, and about twice the length of the body.

Casting a net into a pond in Middle Assam, not presenting any remarkable appearance of containing fish, about 120 were brought up at a single draught; of these forty were *S. pyrropterus*, thirty *Cyprinus chola*, fifteen,



*C. sophore*, eight *S. immaculatus*, ten *Anabas scandens*, Cuv., five *Esox cancula*, Buch., five *Opsarius fasciatus*, J. M., and two *Silurus singo*, Buch. and five *Trichopodus colisa*, id. With the exception of the *Trichopodus* the five last kinds prey upon the *Systomi*, which are themselves insectivorous. The extent of the pond may have been 400 yards, and that of the net three yards; and supposing half the fish to have escaped from under the net, the number in the pond would have been 32,000. When we consider the vast extent of surface occupied by waters equally productive, both in Bengal and Assam, we may form a conception of the inexhaustible supply of fish that might be procured for consumption in other parts of the country where they are less plentiful.

IX.—SYSTEMUS GIBBOSUS, J. M.

t. 44, f. 7. β.

*Cyp. Terio*, Buch.

*Teri pungti* of the fishermen.

Back abruptly arched from the nape to the base of the dorsal, belly straight from the pectorals to the anal, which is placed on an oblique base, as in the Barbels. There is a distinct black spot on the lateral line over the anal. The fin rays are,

D.11 : P.13 : V.9 : A.8 : C.19.

Colours above green, below silvery, the fins pale, the nape, snout, and part of the operculum marked each with a yellow diffuse spot. This and the following species were found by Buchanan in the north eastern parts of Bengal, and are beautifully figured in his collection of drawings. Buchanan says that in old individuals the spot on the tail becomes surrounded by a faint ring.

X.—*SYSTOMUS MALACOPTERUS*, J. M.t. 44. f. 9.  $\beta$ .*Cyp. cosuatis*, Buch.*Koswati* of the fishermen.

Back abruptly arched from the nape to the dorsal, which is somewhat rounded and without a spine; scales large, and black at their bases; lower margin of the body uniformly rounded. The fin rays are,

D.10: P.15: V.9: A.7: C. $\frac{10}{3}$ .

Colour above greenish, without any distinct spots on the sides, below silvery, ventrals light red, other fins pale; found by Buchanan in the Kosi river in the north-western parts of Bengal. I have not hesitated to place it in this group, as well from its general characters as from the remark of Buchanan, that the "jaws protrude much in opening."

The three remaining species are slightly diaphanous, with a chaste and beautiful variety of colour distinctly distributed over the body. The lobes of the caudal are not separated by a deep fissure, thus indicating an affinity to the *Perilamps*; and as such peculiarity of form and diversity in the fixed colours indicate in all similar cases throughout the *Cyprinidæ* carnivorous habits and structure, I cannot view these species as an exception to the rule, until they are proved to be so.

XI.—*CYPRINUS GELIUS*, Buch.t. 44. f. 4.  $\beta$ .*Geli pungti* of the fishermen.

Abdomen and a stripe on each side silvery, an irregular black spot extends over the first three or four rays of the dorsal, as well as ventrals and

anal; a black bar across the tail, and another behind the pellucid abdomen; eyes rather large and elevated. Fin rays,

D.10 : P.13 : V.9 : A.8 : C.19.

Second ray of the dorsal serrated behind. Twenty-five scales along the lateral line, and eight in an oblique row from the base of the ventrals to the dorsum. It is a beautiful little species very common in the Sunderbuns, and is usually found about an inch in length

XII.—*SYSTOMUS LEPTOSOMUS*, J. M.

t. 44. f. 2. β.

*Cyp. phutunio*, Buch.

Green above, abdomen silvery, five black transverse streaks on the sides, ventrals red, second ray of the dorsal indented behind. Fin rays are,

D.10 : P.12 : V.8 : A.7 : C.19.

This species is still smaller than the last, and very much resembles it; but there are only twenty scales in each row on the sides. It is also found in the Sunderbuns where it is caught in creeks, on the return of the tide, by means of small baskets, it is then dried in the sun, and though hardly an inch in length, affords with *Cyp. gelius*, *Cyp. canius*, *Perilampus striatus*, and other equally small species, a considerable supply of food to the poorer classes. Where the larger species are so plentiful, these small kinds are only sought for from the ease with which they may be preserved without salt.

XIII.—*CYPRINUS CANIUS*, Buch.

t. 44. f. 6. β.

Abdomen, opercula, and lateral line silvery; several black spots on the sides, with a black spot at the base of each of the ventrals, and at that of the dorsal and anal fins; rest of the body and fins red, second ray of the dorsal serrated behind.

## II.—GEN. ABRAMIS, CUV.

Body short and elevated, a short dorsal is placed opposite to the ventrals : anal long, colours plain.

The following is the only species yet found in India.

## CYPRINUS COTIS, Buch.

Back raised suddenly from the nape to a salient point, behind which the dorsal is placed ; in front of the first ray of the dorsal there is a small dark spot, but all the rest of the body is silvery. The fin rays are,

D.10 : P.13 : V.10 : A.32 : C.19.

Buchanan makes them,

D.10 : P.16 : V.12 : A.36 : C.19.

Until it be shewn that we have described different species, which I do not think we have, the discrepancy may be supposed to have arisen from the difficulty of counting the fin rays.

The intestine is continuous with a small elongated stomach, and the whole tube scarcely exceeds the entire length of the fish, including the head and caudal

## III.—GEN. PERILAMPUS, J. M.

The Breams, as defined in the Règne Animal, are *Cyprinidæ* that have neither spines nor cirri, their dorsal is short and placed behind the ventrals, and their anal is long. This was quite sufficient to embrace the few species that were known at the time ; for although several editions of the zoological system of Cuvier appeared subsequently to the publication of the Gangetic Fishes, in which many of the species composing the genus *Perilampus* are described, yet the retention of Buchanan's drawings in India not only deprived

that author of much of the merit to which his labours as a naturalist entitled him, but the world at large of the masterly elucidation of this subject that might have been expected from the hand of Cuvier.

Notwithstanding the very general assemblage of forms that Cuvier's definition of the genus *Abramis* might be supposed to admit, the European species only amount to five, and three of these are peculiar to the tributaries of the Baltic. I found, however, upon a close examination of Indian *Cypri-nidæ* that if we were to content ourselves with the characters given of the Breams by systematic writers, we should not only confound at least two natural groups, but augment our Indian species of that genus to about thirty five in number.

From this vast accession of materials, for which we are chiefly indebted to Buchanan, I am enabled to distinguish two natural genera, *Perilampus* and *Opsarius*, and to suggest something like natural limits to the hitherto ill defined genus *Leuciscus*. Before entering upon the consideration of any one of these groups, it is necessary to offer a few remarks on their general distinctions.

The Perilamps, so called from the brilliancy and variety of their colours, as well as the Opsarions, or fish-eaters, seize their prey by means of a sudden effort or spring, for the performance of which the great breadth of fin appears to be accumulated behind. The mouth is armed with a prominent knob on the apex of the lower jaw, more or less sharp in the several species; when the mouth is closed this knob is received into a corresponding fissure in the upper jaw: thus far the two groups agree, but in the general development of their forms and structure, nature has assigned to each a totally distinct organization, adapted to the peculiar ends for which the species were designed. Between the two groups here alluded to the *Leucisci* occur, consisting perhaps of species that might be referred on the one side to the Perilamps, and on the other to Opsarions, rather than forming, by any distinct structure or habits of their own, a natural group.

The Perilamps, or first of the three groups in question, seem to follow the Breams as next in the direct relations of habit and structure. Our only Indian Bream has the short alimentary canal of the *Sarcoborinæ*, and those of Europe appear to indicate a somewhat corresponding disposition for animal food. Such is particularly the case with *Abramis blicca* which, when seizing live bait, according to Mr. Yarrell, is more prone to rise than to descend, causing the float to lie horizontally on the water rather than to drag it like other species beneath the surface. This may or may not indicate an affinity to the habits of the Perilamps, though the form and colour of the species in question are in favour of the affirmative; I merely allude to this peculiarity, which is referred to by Mr. Yarrell on the authority of Mr. Lubbock, as a singular circumstance, probably capable of explanation by reason of the affinity here suggested.

The first species in which we observe a decided approach to the characters of the Perilamps is *Cyprinus devario*, Buch., which combines the long anal and form of a Bream with the dorsal of a *Cyprinus proprius*, and the mouth and real markings of a *Perilampus*. As the latter group, and consequently the peculiarities by which its species are distinguished were unknown until now, some of the most striking characters which belong to it were lost sight of in the figure of *Cyprinus devario* given by Buchanan. The mouth is directed upward, and although the peculiar prominence of the apex of the lower jaw is absent on this species, yet the deficiency in this respect is compensated for by a slight roughness on the lower jaw, first observed by Buchanan, and which he thought "might perhaps be considered to be teeth," without a suspicion that an indication of any maxillary structure equivalent to prehensile teeth in this family should prove the carnivorous propensities of the species possessed of such peculiarity, and that both in structure and mode of life they should be found perfectly distinct from ordinary Cyprins.

## PERILAMPUS, J. M.

CHARACTERS.—Head small and raised, suborbital plates broad below, and narrow behind the eyes: mouth small, and directed upward, so that the apices of the jaws are raised to the altitude of the crown, the lower jaw is armed at the point with a blunt knob or equivalent organ to teeth. The tongue is thick and wrinkled. The body is much compressed; the back straight or only very slightly raised under the dorsal; the belly or lower margin is very prominent, and the sides are marked with bright colours, mostly blue. The caudal is large, a small dorsal is placed opposite to a large anal, the ventrals and pectorals are small, but in some the ventrals are composed of elongated rays, apparently to facilitate the effort to rise into the air.

They are without spines, and often with long setaceous cirri.

## I.—CYPRINUS DEVARIO, Buch.

t. 45. f. 2.—P. G. t. 61. f. 94.

This species has been referred by Cuvier to his sub-genus *Cyprinus proprius*. To me that group does not seem to be either natural or well defined, in as much as the dorsal spine is by no means commonly associated with a lengthy dorsal fin; indeed both the characters alluded to are so artificial that they cannot be had recourse to in forming any group of *Cyprinidæ*. Authors from a diffidence to reject altogether a group that has received the sanction of so high an authority as Cuvier, are continually in the habit of modifying the characters of the group in question, to suit the particular species they meet with, as I have done to bring *Cyprinus semiplotus* into it; but were I acquainted sufficiently with European species, I might have had no hesitation in making *Cyprinus semiplotus* the type of a new group. *Cyprinus carpio*, on which the group is founded, seems to me to be strictly a Barbel, uniting that genus with

the Cirrhins; the remaining species of *Cyprinus prop.* may be formed into a natural group characterised by a long dorsal and the absence of cirri: view the subject as we may, however, *Cyprinus devario*, Buch. is not only different from the true Cyprins, but from the whole of the *Pæonominæ*.

The body is much compressed, narrow, and deep; the head small, without cirri; the dorsal and anal long, opposite, and without spines; the fins feeble, the mouth raised obliquely upwards, and the sides marked each with a broad purple streak, and the abdominal canal, which is continuous with the stomach, is altogether only equal to about the length of the body. For these reasons I regard *Cyprinus devario* as a *Perilampus*, presenting relations of analogy only to *Cyprinus proprius*, as indicated by the arched back and the long dorsal.

The following are the characters by which it may be distinguished,—depth equal to half the length, back arched, dorsal long, sides marked with a single interrupted crooked light blue streak extended over the caudal, jaws rough, with a blunt knob on the apex of the lower jaw, which is narrow and directed upwards. The fin rays are,

D.18 : P.10 : V.8 : A.18 : C.19.

There are about forty scales along the lateral line, which descends along the third row of scales from the ventral margin. Seldom attains more than two inches in length, and is common in Bengal and Assam.

## II.—PERILAMPUS OSTREOGRAPHUS, J. M.

t. 45. f. 3.

The depth is almost equal to half the length of the body; the back is straight from the snout to the caudal, and the lower margin or abdomen is much rounded and protuberant; the head is small, directed obliquely upward, the body much compressed, and the sides are marked with several



distinct purple stripes extending from the branchial aperture to the extremity of the caudal; the colour of the back is bluish black, and of the abdomen reddish white or pink; the caudal is almost entire, the middle rays being very little shorter than the outer. Fin rays are,

D.12 : P.15 : V.8 : A.16 : C.19.

Thirty-five scales along the sides in depressed oblique rows, and about fifteen from the base of the ventrals to the dorsum. The mouth like the head is directed upwards, and has a prominent knob on the apex of the lower jaw; the tongue is thick and corugated.

The stomach of this fish is about half the length of the body, and terminates in an intestine equal to about the length of the body. The intestine is reflected over upon the stomach, and from thence extends straight to the vent. In the stomach of all those I have examined I found nothing but the remains of insects, such as live on the surface of waters.

The liver extends in a single lobe along the surface of the stomach, to which also the spleen adheres loosely. There is a peculiarity in the air vessel of this species, for instead of being a distinct organ it seems to be either wanting, or merely formed by a duplicature of the lining membrane of the abdomen which forms an air cavity under the spine.

This species is found throughout Assam in small indolent streams, as well as in the larger rivers. It is also abundant in some parts of Bengal, though it is one of the few species that escaped Buchanan's observation. It usually attains about three inches in length, but its great depth and abundance in some places renders it of value as an article of food.

PERILAMPUS ÆQUIPINNATUS,\* J. M.

t. 60. f. 1.

For this very well marked species we are indebted to Mr. Griffith's researches in Assam, although it escaped my notice until very recently,

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\* Etym. *Æqualitas* and *pinna*; in allusion to the dorsal and anal being of equal size.

when engaged replenishing the spirits in which a portion of Mr. Griffith's extensive botanical collections are preserved, during his absence with the army of the Indus.\*

The depth of the body is from one-third to one-fourth of the entire length. The pectorals and ventrals are short, the dorsal and anal are of equal size, and the lateral line descends close to the lower margin of the body. The fin rays are,

D.13 : P.13 : V.9 : A.13 : C.19.

There are thirty-two scales along the lateral line, and eight rows from the base of the ventrals to the dorsum. The length of the intestine and stomach together are equal to about the length of the body, inclusive of the head and caudal. The mouth is directed obliquely upwards, with a blunt knob on the apex of the lower jaw, tongue thick and corugated.

#### IV.—*PERILAMPUS GUTTATUS*, J. M.

t. 45. f. 4.  $\beta$

*Cyprinus laubuca*, Buch.

This species was found by Buchanan in the ponds of the north-eastern parts of Bengal. In other parts of the province it would seem to be more rare, as I have only met with one specimen. It is a well proportioned, handsome species, and Buchanan remarks that each nostril consists of but one

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\* Like several other specimens of fish preserved in spirits along with plants in the same collection, it retains its perfect freshness and form, with a far greater degree of solidity than if it had been kept alone in spirits. This fact may be of some practical use to naturalists with whom it is of course an object to preserve the greatest variety and extent of collections during their travels. It has already been three years in spirits in an Indian climate, and might, to all appearance, keep for ever in the same state; the only disadvantage is that the colour alters to a deep brown or black, but this is removed by subsequent maceration in fresh spirits.

aperture. The usual septum which appears to divide the nostrils of *Cyprinidæ* into two is in this species placed somewhat horizontally so as to form a valve, in which however there is a second aperture.

The head is small, the mouth obliquely raised, the tongue large, and a pointed process is placed on the apex of the upper jaw, with two prominent obtuse points on the lower one; the depth of the body is equal to about a third of the length, the pectorals are long, the ventrals very small, the body inferiorly much compressed, the post-operculum triangular, with a green spot on either side above the base of the pectoral fins. The fin rays are,

$$D.10 : P.12 : V.7 : A.24 : C.\frac{10}{9}.$$

The lateral line descends low along the sides, and beneath it the scales are small, thirty-four in a row on either side, and about seven from the lateral line to the base of the dorsal fin; dorsal and anal opposite.

The stomach and intestine together are scarcely equal to the length of the body.

V.—*PERILAMPUS PERSEUS*, J. M.

t. 48. f. 5.

This species presents all the peculiar characters of the *Perilamps*, in the most prominent degree. The head is small, the back straight from the snout to the caudal, and the mouth may be said to be placed in the upper part of the head so as to be carried along the surface of the water when swimming. The pectorals and ventrals are very long, and each side of the body is marked with a light blue streak. The fin rays are,

$$D.9 : P.18 : V.5 : A.21 : C.—?$$

The caudal is much divided, but the only specimen in my possession is so much injured that I am unable to determine with accuracy the number of scales and caudal fin rays.

VI.—*PERILAMPUS PSILOPTEROMUS*, J. M.t. 46. f. 4.  $\beta$ *Cyp. atpar.* Buch. *C. loyukula*, id. Coll.

In this species we perceive a form no less adapted to insectivorous habits than that of the last, but from the great breadth of fin accumulated on the hinder parts of the body or tail, and the oblique insertions of the dorsal and anal fins which bring their propelling power into operation with the caudal in the direction of the long axis of the body, we may conclude that it captures insects rather by sudden springs into the air, than by a rapid course along the surface. Were further proof of this required, we have only to refer to the elongated ventrals which, like stilts, serve to support the vertical position when the anterior parts of the body are emerged from the surface, and to break the fall and preserve the natural balance on returning again into the water.

The body is much compressed, its depth equal to about half its length exclusive of the caudal and head. The mouth is directed obliquely upwards, and the ventral fins are equal to half the length of the body, narrow, and composed of few rays. The abdomen is silvery, and a bright blue line extends along each side from the branchial aperture to the caudal. The fin rays are,

D.9 : P.11 or 12 : V.5 : A.25.

This species grows to about three inches in length, and was found by Buchanan in the Bramaputra, the Ganges, and Jumna.

VII.—*CYPRINUS CACHIUS*, Buch.

t. 46. f. 6.

Diaphinous with a glossy iridescence changing to green, purple, and silvery on the belly; ventrals slender, and attenuated as in the last. The fin rays are,

D.7 : P.8 : V.3 : A.26 : C.—?

It is found in the Ganges about the commencement of the Delta, and is scarcely an inch in length.

VIII.—*PERILAMPUS RETICULATUS*, J. M.

t. 45. f. 1.  $\beta$

*Cyp. dangila*, Buch.

Four cirri; length of the head to that of the body as one to three, exclusive of the head and caudal; depth of the body to the length, as two to five. The sides are ornamented with reticulated narrow blue stripes, below silvery, above olive green, dorsal opposite to the commencement of the anal. The fin rays are,

D.13 : P.12 : V.7 : A.17 : C.20.

The caudal fin is almost entire. I have only seen a single specimen of this fish in Calcutta; according to Buchanan it inhabits rocky streams south of Monghyr, and is said to attain about the size of the finger.

IX.—*PERILAMPUS STRIATUS*, J. M.

t. 46. f. 1.  $\beta$

*Cyprinus rerio*, Buch.

A very beautiful little species, found by Buchanan in the Kosi river on the northern boundary of Bengal, but which is also very common in the Sunderbuns, where it seldom attains above an inch in length.

It has four setaceous cirri, two very long and two short, in front of the nostrils. The sides are marked with eight or nine alternate stripes of blue and silver; several distinct blue stripes on the caudal and anal fins; colour above olive, below silvery. The dorsal fin is placed opposite to the

commencement of the anal, and is rounded, the middle rays being longest. The fin rays are,

D.8 : P.9 : V.7 : A.17 : C.18.

The figure, which is from Buchanan's collection, is an excellent representation of this remarkably brilliant species.

X.—*PERILAMPUS RECURVIROSTRIS*, J. M.

t. 46. f. 2.  $\beta$ .

*Cyprinus jogia*, Buch.

A small species with four fine setaceous cirri, and a dark blue stripe extending from the eye along the middle of each side to the caudal. Length of the head equal to the depth of the body, and one third of the length exclusive of the head and caudal. The jaws are slightly recurved, and the form slender and graceful; the anal small, but placed far back and opposite to the end of the dorsal. The fin rays are,

D.8 : P.10 : V.8 : A.7 : C.19.

Twenty nine scales along the lateral line, and six rows across the body from the ventrals to the dorsum on either side. Found by Buchanan in the Kosi river, but also very common in the Sunderbuns and in ponds at Calcutta. The following is perhaps a variety only,—

XI.—*PERILAMPUS MACROURU*, J. M.

t. 46. f.

*Cyprinus sutiha*.

A small species with four fine setaceous cirri, two of which are very long. The form is much compressed, the first ray of the fins prolonged to a slender point; the sides are marked with a faint blue silvery line. The fin rays as in the last. This species is found in like manner throughout Bengal.

## XII.—PERILAMPUS THERMOPHILUS, J. M.

t. 54. f. 19.

This curious little species was found in hot springs at Pooree by Mr. Cumberland, by whom two specimens were presented to the Medical Society, and afterwards obligingly submitted to me by the Secretary, Dr. Goodeve.

The head is directed obliquely upward, and the tail downward. The caudal fin is however imperfect in both the specimens.

Two short cirri in front of the upper jaw, and two long setaceous bristles at the angles of the mouth; thirty-one scales along the lateral line, and seven rows of scales from the base of the ventrals to the dorsum; chin rounded and placed in front of the mouth. The fin rays are,

$$D.8 : P.9 : V.8 : A.7 : C.—?$$

The temperature of the springs in which this species is very common was remarked by Mr. Cumberland to be 112° Faht. but they are said to die when placed in water heated to 120° Faht.

The last three species from the small size of the anal fin should, were we to be guided by that character alone, be placed with the *Leuciscs*; but the small and obliquely raised head, peculiar form of body, and opposite position of the dorsal and anal fins, are characters which are not to be overlooked.

On the other hand, there are species placed with other genera which might be said to belong to this, as *Cyprinus daniconius* among the *Leuciscs*, and *Opsarius leucerus*; the first from having the lateral stripes of the *Perilamps*, and the second from its obliquely raised head; but in *Cyp. daniconius* the dorsal fin is opposite to the ventrals and the head is large, and although *Opsarius leucerus* has the head as well as the habits of a *Perilamp*, yet it has the elongated and slender form of an *Opsarius*, with the dorsal opposite to the anal, characters which separate it from the *Leuciscs*.

*Remarks on the Genus.*

The lengthened rays of the pectoral and ventral fins of *Perilampus perseus*, together with the broad surface of the anal, enable it to move along the surface of the water in pursuit of flies and other insects,—a mode of life for which every part of its structure is admirably formed. The mouth, as already stated, is so constructed as to be carried above the surface, even when other parts of the body are submersed. This essential peculiarity of a species that derives its subsistence exclusively from an element superincumbent to that which it inhabits is effected by means of the lower jaw, which instead of being horizontal, or even slightly inclined, is placed almost vertically in front of the mouth, so that the apex of the jaws are higher than any other part of the body, and diametrically opposite to what obtains in the ground-feeders, or typical *Pænomindæ*, and implies a totally different economy from what belongs to those *Sarcoborinæ* that derive their food from within their own element. In these last, as we shall see in the genus *Opsarius*, or fish-eaters, the mouth is wide,\*unencumbered with a tongue, and extended straight forward. A tongue indeed to animals that swallow living prey approaching in an incredible degree to their own size, would be an useless appendage. The mouth of the Opsarions is therefore to be regarded as little more than a prehensile apparatus, equivalent to the claws and hands of other animals; but in the fly-catchers, or Perilamps, the mouth is furnished with a large rugose, and we may presume highly sensible, tongue, which is requisite for conveying into the stomach minute objects that would otherwise adhere to the sides of the mouth.

In none of the Barbels, Cirrhins, or Gudgeons, nor in any of those groups that live on plants, shell fish, or other objects obtained by scraping or rooting in mud, do we find any thing like a soft or sensible tongue, the office of which is in many cases better performed by cirri.



Cirri however, when they do occur in the Perilamps, are of that setaceous character which we observe in birds of similar habits, and their use in both cases is the same. But for this unity of design that extends throughout nature, reconciling to certain ends all the infinite variety we behold, we might justly exclaim—How perplexing must the study of nature be, when a single group presents such diversity in form and structure as belongs to the *Cyprinidæ*! A wider view however of those relations of analogy and affinity pointed out by Mr. Macleay dispels all our difficulty, and we find by this means, that a knowledge of one group serves us as the key to every other. After passing through the first section of the Perilamps, the remaining species are furnished with slender setaceous cirri, as already stated, and their low and elongated shapes gradually bring us back again to the ordinary form of *Cyprinidæ*. Their graceful forms, peculiar structure, and brilliancy of colour still however mark them as Perilamps, and certainly give this group an equal claim to beauty in its own circle, with the fly-catchers and butterflies of other classes in theirs. Nor can we altogether say that the dense and gloomy medium to which the Perilamps in common with all fishes are consigned, prevents them from contributing, like corresponding types in other classes, to cheer and enliven the solitary landscape. With fishes we have certainly fewer sympathies, be their beauty what it may, than with beings whose occupations and business of life are carried on before our eyes; but to those whose thoughts are accustomed to dwell on the works of nature, all living beings present something to excite either wonder or admiration. During the stillness of morning, before sun-rise, as well as on the approach of twilight, the Perilamps are almost the only disturbers of our peaceful lakes, and at those hours in particular the surface of ponds is kept in constant ripple by Perilamps in pursuit of insects. Numerous troops of them may also be observed advancing with the tides in the Hoogly and other rivers in Bengal, where they separate into small bands on either side of the current, and spreading with the waters over shallow banks and low inundated tracts covered with vegetation, constitute

with the insects they pursue, and the king-fishers and wading birds which they attract and support, a very lively and interesting part of the scene, to those whose attention has been once directed to the circumstance.

#### IV.—GEN. LEUCISCUS.

The *Ables*, or white fishes, were distinguished by Klein, a naturalist of the last century, by the following characters—"Dorsal and anal short; neither spines nor cirri, and nothing particular about their lips." Cuvier, however, observes that species with cirri occur, and instances *Cyp. danrica*, Buch., and although I have referred that species to the Perilamps, still I have replaced it by *Cyp. coesa*, Buch., as well as *Cyp. elanga*, id, both of which have cirri. Cuvier in addition to Klein's characters distinguished *Leucisci* into smaller divisions, according to the position of the dorsal fin, which he remarks is not always clear. The genus, he observed, is rich in species; but this is the case with all ill defined groups, it being often as difficult to determine what does not, as what really belongs to them.



#### LEUCISCUS PROPRIUS, J. M.

Dorsal and anal small, without spines, the last ray of the former placed anteriorly to the first of the latter fin, so as to bring it at least opposite the space between the ventrals and anal, if not opposite to the ventrals. The sides are white and silvery, presenting little variety of colour; the scales are covered with a pearly pigment; the mouth is either horizontal or directed upward; the lower jaw is armed with one or more blunt prominences, or where these are wanting, its apex is received into a fissure in the upper jaw.

The stomach and intestines are scarcely longer than the body, the intermaxillaries are not protractile.

The effect of the foregoing definition, the substance of which may be expressed in a few words, as in the synopsis, is to exclude *Cyp. boga*, Buch. *Cyp. ariza*, id. *Cyp. sophore*, id. and *Cyp. danrica*, id. from this genus, though referred to in the Regne Animal as *Leucisci*. The two first are Gudgeons, the third is a *Systomus*, and the fourth is a Perilamp, thus reducing the seven Indian species of this genus indicated by Cuvier to three. But in place of those removed we must add *Cyp. coosa*, Buch. as its alimentary canal scarcely exceeds the length of the body, while that of the Barbels, with which it stands in the Regne Animal, varies from three to six times that length; it is besides without the dorsal spine of the Barbels, while it has faint bars across the body, indicating an approach from the *Leucisci* to the Opsarions. Six other species, most of which I have carefully examined, must also be added, making the number of our Indian *Leucisci* already known amount to ten.

The improvement, if there be any in this restriction of a genus acknowledged before to be imperfect, must rest a good deal on the principle, that nature in fixing the position of the dorsal fin, determines from this, what shall be the concurrent habit and structure of the species.

In looking over the descriptions of the six European *Leuciscs* whose dorsal is opposite to the ventrals, we find the anal small, and the mouth low and horizontal, as if exclusively formed for obtaining their food from the bottoms of waters, and we know this to be further confirmed by the fact of their subsisting chiefly on herbage and worms. We then arrive at Cuvier's second division of this genus, in which the dorsal is placed behind the ventrals. Now, when the dorsal is placed so far behind the ventrals as to be opposite to the anal, I no longer regard the species as *Leuciscs*, but Perilamps or Opsarions, according as they correspond in most respects with one or other of those genera. If we take the Rudd (*L. erythrophthalmus*) as an example, we find it is marked by the receded position of the dorsal, the greater development of the anal, the upturned mouth, and the remarkable brilliancy of colours, all denoting an affinity to the Perilamps; which is further confirmed by a cor-

responding tendency to carnivorous habits ; its food being, according to Mr. Yarrell, " worms, molluscous animals, and insects, with some vegetable matter." *Leuciscus alburnus*, another European species, the dorsal of which is placed opposite to the commencement of a large anal, possesses a blind appetite for insects to such a degree as to render it an excellent amusement for young fly-fishers, and the activity of this species in seizing insects is the poetical theme of all field naturalists. This species may also, as well as *Cyprinus cultratus*, Lin., be referred either to the Perilamps or to the Opsarions ; but this question I leave to be determined by the naturalists of Europe, where these species are found.

The position of the dorsal and size of the anal therefore become natural characters, and appear sufficient to enable us to discriminate clearly between the Leuciscs and the adjoining groups.

For the right application of these characters, it is necessary to state that we must regard those cases in which the first ray of one fin is opposite to the last ray of the other, and *vice versa*, as opposite fins ; and thus we shall very rarely have occasion to remark the position of the dorsal as opposite to the interval between the ventrals and anal, without being more or less opposite to one or other of the latter fins. When such a case happens, the species must be regarded as a Leucisc if the anal be small, and either Opsarion or Perilamp if the anal be large.

*Cyprinus daniconius* has the form of a Leucisc, with the markings of a Perilamp on the sides. In Buchanan's collection there is a figure of another variety which I have not met with, *Anjana* of the natives, P. G. 328, which in the synopsis I have placed with the Leuciscs under the name of *L. lateralis*, but which we might have equal reasons for placing with the Perilamps. It has in fact the mouth and lateral streaks of the latter genus, with the general form and fins of a Leucisc, so that it would be just as accurate to place it in one genus as in the other. In size and general form it corresponds precisely with *Cyprinus daniconius*, but differs from it in having the head more compressed,

and the jaws recurved directly upwards, with a sharp point on the apex of the lower jaw; both are so nearly allied to each other, and correspond so much with the *Leuciscus* in the form and disposition of their fins, that we may describe them together in the same genus, although perhaps the true place of the one would be at the close of the *Perilamps*, and of the other, at the commencement of the *Leuciscus*.

I.—*LEUCISCUS LATERALIS.*

*Cyprinus anjana*, Buch, Coll.

The dorsal is placed opposite the ventrals, anal small; a blue stripe extends from the mouth over the operculum on either side to the caudal. The head is more compressed than the body, the jaws somewhat flattened and directed upwards, with a short point on the apex of the lower one, which is received into a corresponding fissure in the upper jaw. There is a depression on the crown, from which the jaws appear recurved, and this is the only difference in the figure of this species from that given of *Cyprinus daniconius*, P. G. t. 15. f. 89. The fin rays are,

D.9 : P.13 : V.9 : A.7 : C.19.

II.—*CYPRINUS DANICONIUS* Buch.

P. G. t. 15. f. 89.

The arch of the back descends equally from the base of the dorsal to the apex of the jaws, without a depression at the nape, or on the crown. The head and body are equally compressed, the sides are marked with faint streaks more or less apparent in different specimens, but often obscure and merging to grey and yellow. The mouth is horizontal, and the head placed in a line

with the axis of the body, as in the genus *Leuciscus*, with which it corresponds in the form and disposition of the fins; the rays of which are,

D.9 : P.14 : V.9 : A.8 : C.20.

There are forty scales along the lateral line, and nine rows from the ventrals to the dorsum.

### III.—*LEUCISCUS DYSTOMUS*, J. M.

*Cyp. elonga*. Buch, Op. Cit. 281.

Length of the head to that of the body as one to three, mouth small and directed upwards, with a round knob at the apex of the lower jaw very prominent, two minute cirri are placed at either side of the mouth, opercula slightly pointed behind, suborbital plates a little broader behind than below the eyes; brachial plates projecting slightly over the origin of the pectorals. The fin rays are,

D 9 : P.15 : V.9 : A.7 : C.19.

Forty scales extend along the lateral line, which descends to within four rows of the ventrals, and eleven scales are found in each oblique line from the base of the ventrals to the back. The scales are soft, quite transparent, with a silvery lustre and colour except on the back, where the colour is greenish yellow.

The stomach is small and pyriform, terminating in a short straight intestine; the liver consists of (two?) elongated lobes. The spleen is in this species of considerable size, and of a bright red colour and elongated shape, and is placed between the left lobe of the liver and the stomach. This species, which may be considered to partake equally of the habits of the *Perilamps* and *Opsarions*, is very common in most of the rivers and ponds of Bengal and Assam; its usual size is from six to eight inches in length; its flavor is good, but it is not

so common as to entitle it to any degree of importance, and its habits would render it objectionable in fish ponds. Its food consists chiefly of small fishes and insects, the remains of which have been found in its stomach.

## IV.—CYPRINUS RASBORA, Buch.

Op. Cit. Pl. 2. f. 60.

Depth equal to one-fourth of the entire length ; body much compressed, and equally arched above and below ; mouth directed upwards, with three blunt knobs on the lower jaw ; head small ; opercula sharp-pointed behind ; scales large, about twenty-five along the lateral line, and seven in an oblique row from the base of the ventrals to the dorsum. The fin rays are,

D.9 : P.13 : V.9 : A.8 : C. $\frac{10}{9}$ .

Caudal fin tipt with black ; body greenish grey above, with a leaden hue on the lateral line ; dirty greyish yellow below. This description is taken from a specimen in spirits brought from Upper Assam by Mr. Griffith ; the colours are no doubt more marked in fresh or living specimens.

The stomach and intestine taken together are scarcely longer than the body, the abdominal canal is however capacious, and loaded with the remains of insects.

## V.—CYPRINUS MOLA, Buch.

Op. Cit. Pl. 38, f. 92.

*Moah*, of the Assamese.

Scales very small, colour white, opercula rounded behind, and tip of the caudal without any dark colour. The fin rays are,

D.9 : P.15 : V.9 : A.7 : C.19.

Instead of a knob, the apex of the lower jaw is furnished with a sharp recurved edge; the length of the head to that of the body as one to three; the intestine and stomach form a canal nearly twice the length of the body.

The usual size of this species is about four inches, it is very common in ponds and rivers throughout Bengal. There is a small diaphinous variety also very common in Assam, where both kinds are understood by the same name by the natives—*Moah*, said to be derived from the name of an insect on which they feed. In this last variety I found the fin rays to be,

D.8 : P.16 : V.9 : A.6 : C.19.

There is still a third kind, white and silvery like the preceding, with small scales, but more translucent and slender; it is called by the fishermen *Dorikana*. I have named it *L. pellucidus*, but have not obtained sufficient information to notice it separately in this place; its distinguishing characters are noted in the synopsis.

In the preceding species the anal is smaller than the dorsal, and the mouth is directed slightly upwards; but in the following the anal is as large, or larger than the dorsal, and the mouth horizontal.

#### VI.—CYPRINUS APIATUS. Jacquem.

*Voy. Dans l'Ind.* t. 15. f. 3.

This species I have not met with, but it is figured in M. Jacquemont's travels in India; and though no description has yet appeared of it, I may add the following note taken from the drawing, which may be sufficient to characterise the species. It appears to have been found in the Jumna.

Depth equal to about half the length, exclusive of the head and caudal, snout and margin of the lower jaw perforated by numerous mucous pores; dorsal and anal contain about nine rays each.



## VII.—CYPRINUS CHEDRA, Buch. Coll.

Hardwicke's Illust. t. f.

The most remarkable character of the fish represented by Buchanan under this name, is the contraction of the body between the ventrals and anal, and the recurved direction of the tail, causing a convex, or oblique surface over the insertion of the anal, as in the Barbels. The fin rays, as stated by Buchanan, are,

D.10 : P.14 (?) : V.9 : A.11 : C.18.

There are two circumstances that induce me to suspect the peculiarity in form above noticed to be accidental, or a fault either in the drawing or in the specimen from which it was taken; the first is, that Buchanan does not notice it in his description; and the second, that the fish from which the following description was taken appears to me to be the same species, though differing in the number of rays in some of the fins.

## VIII.—LEUCISCUS BRACHIATUS,\* J. M.

Pl. 42. f. 5.

Length of the head to that of the body as one to three, and greatest depth is equal to the length of the head; suborbital plates of uniform breadth, scapular and brachial plates present a broad silvery surface behind the opercula; forty-four scales are ranged along the lateral line, which descends to the fourth row of scales from the ventrals; ten scales in an oblique row from the base of the ventrals to the dorsum; at the base of each scale there is a small black spot. The fin rays are,

D.8 : P.14 : V.9 : A.10 : C.18.

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\* The specimen from which my figure and description were taken, was presented to the Asiatic Society by Mr. Hodgson. I have since however obtained several from Mr. Griffith.

The colour is dark bluish along the back, with a dark streak across the dorsal fin, which with the anal and caudal are tipped with black ; the ventrals are small, and rounded. Mr. Griffith states that this species is common in the rapids of the Bramaputra, and most voracious in its appetite for flies.

IX.—LEUCISCUS MORAR,

*Cyprinus morar*, Buch.

Op. Cit. Pl. 31. f. 75.

*Cyprinus bukrangi*, id. Coll.

The mouth is small, placed behind a prominent and narrow snout. Back green, sides entirely white, and silvery; scales large and covered with a copious pearly pigment. About forty scales along the lateral line, and nine rows from the base of the ventrals to the dorsum. The lower lobe of the caudal longer than the upper; suborbital plates extend forward to the corners of the mouth; snout fleshy and prominent. The fin rays are,

D.10 : P.15 : V.8 : A.12 : C.20.

This species is very abundant in the Bramaputra, is about three or four inches in length, and as Buchanan justly observes, is high flavoured and much sought after as a delicacy; stomach and intestine form a thick fleshy canal equal to the entire length of the body, inclusive of the head and caudal. In addition to it, Buchanan has figured another variety, *Bukrangi*, in which the lobes of the caudal appear to be less divided, and the scales marked with slight *striæ* in the drawing, and the membrane of the fins dotted, and a slight tinge of yellow on the lower parts of the body. I have not seen this species, nor can I find it described in the Gangetic Fishes.

X.—*LEUCISCUS MARGARODES*, J. M.

*Cyp. jaya*, Buch. Coll.?

*Chola* of the Assamese.

The mouth is small, placed behind a prominent and narrow snout; scales small, about fifty-four in a row along the lateral line, and eighteen in an oblique line from the ventrals to the dorsum; they are easily detached, and are covered with a copious pearly pigment; lobes of the caudal of equal length; back green, sides silvery, two anterior suborbital plates extend to the upper lip on either side. The fin rays are,

D.9 : P.15 : V.8 : A.9 : C.19.

The stomach and intestine forms a thick capacious fleshy canal, equal to about one and a half lengths of the body, inclusive of the head and caudal. This species resembles *Cyprinus morar* so closely in form that I have not figured it. It is also found in the Bramaputra, especially in Upper Assam.

XI.—*CYPRINUS COCSA*, Buch.

Op. Cit. Pl. 3. f. 77.

Four cirri; back green; sides, opercula, and lower parts of the body silvery; faint streaks descend partially from the back to the sides, as in the genus *Opsarius*; suborbital plates occupy the space between the eye and the corner of the mouth on either side, as in the last two species; mouth horizontal; forty-two scales along the lateral line, and eleven in an oblique line from the ventrals to the back; snout prominent and deep, with a depression in front of the upper jaw for the reception of the apex of the lower, which is without a prominent tooth. The fin rays are,

D.9: P.13: V.9: A.10: C.19: .

The stomach is large and muscular, about one-third of the length of the body, with its pyloric reflected and terminating in one large intestine a little longer than the body, or about twice the length of the stomach.

Cuvier has indicated a place for this species among the Barbels, but as we have no instance of Barbels having longer anal than dorsal fins, I have no hesitation in placing it with the Leuciscs, notwithstanding its cirri. In this I am guided equally by its peculiarly bright colours, its short alimentary canal, and comparatively large anal. Its markings however denote an approximation to the Opsarions. I may further remark, that *Cyprinus culbasu*, Buch. *Cyprinus rohita*, id., *Cyprinus gonius*, id., and *Cyprinus daniconius*, id., are also indicated in the Règne Animal as Barbels. The two first are Cirrhins, the third a Labeo, and the last a Leucisc.

## XII.—LEUCISCUS ELINGULATUS, J. M

t. 57. f. 4.

The tongue is variously developed in the *Leuciscus*, according as the habits of the species approach to those of the Perilamps, in which it is usually large and rugose ; or to those of the Opsarions, in which it is almost absent ; or to those of *Pænominae*, in which it is usually cartilaginous. In this species, however, which is a native of mountain streams at Simla, where it was found by Dr. Macleod, the tongue is almost quite absent.

It was first described in the seventh volume of the Journal of this Society, from a single specimen, as a Perilamp ; but its form though stout and short, is that of a Leucisc. The head and fore part of the body deep ; brachial plates slightly exposed behind the opercula ; snout round, and terminates abruptly in front of the eyes ; forty-six scales are ranged along the lateral line, and eleven in an oblique row from the base of the ventrals to the dorsum ;

colours plain,—at least after having been for a time in spirits. The fin rays are,

D.9: P.13: V.9: A.10: C.19.

The stomach and intestine form a tube equal to about the length of the body.

V.—GEN. OPSARIUS, J. M.

The body of the Opsarions is either long and slender, or considerably compressed; the mouth is large, the symphysis of the lower jaw is hard, and received into a fissure in the apex of the upper jaw; but in the more typical species it is armed with a larger prominence than in others. The back is but slightly raised, but the abdominal margin is more prominent; the sides are either plain, or marked with transverse green bars or spots. A short dorsal is placed far back upon the body, nearly opposite to a long anal. They are without spines or cirri.

They afford instances of the shortest alimentary canal in the family, and in no case does the entire tube including the stomach, which is usually longer than the intestine, much exceed the length of the body, though it is occasionally much less.

The abdominal cavity is long, and almost entirely occupied with a strong muscular stomach capable of great dilatation, narrowing in its capacity gradually to the pylorus, where it is joined by a short fleshy intestine, which gradually contracts towards the vent. The liver consists of two elongated lobes extending along the stomach; the air-vessel is very long and narrow, extending the whole length of the abdomen close under the spine, so as to be less exposed to injury during violent struggles in which the species of this genus necessarily engage with their prey. Their habits are extremely voracious and carnivorous, and their whole form constructed for

rapid swimming and sudden efforts essential in procuring prey, which consists chiefly of Gudgeons and other elongated spineless species, which are swallowed entire.

The four first species of the group are white, with long falciform pectorals; the mouth and head obliquely raised with regard to the axis of the body, as in the Perilamps, with which *Cyprinus bacaila*, Buch. and *O. leucus* agree in habits, living exclusively on insects. *Opsarius pholicephalus* is however a most destructive and voracious fish-eater. The habits of *O. albulus* are as yet unknown, but they no doubt correspond with one or other of the adjoining species. These four are strictly Buchanan's *Chelæ*, and from their compressed and prominent abdominal margin, as well as their form, certainly do evince a relation to the *Clupeæ* as Buchanan supposed; but that this is merely a relation of analogy, we may conclude from the want of *cæcæ*, as well as the hard serrated abdomen, while the head corresponds with that of the Perilamps, and the abdominal canal with that of the Opsarions. Buchanan's name *Chela*, may therefore be retained for them as a sub-genus. The remaining species of the group however are very different; the mouth is horizontal, the head larger and longer, and the body not more compressed than that of the *Salmonidæ*, from which they differ in their shorter and more capacious intestinal canal, which is without *cæcal* appendages, and in the absence of teeth, while their direct affinities confine them to the *Cyprinidæ*, although carnivorous in the very highest degree.

#### I.—CYPRINUS BACAILA, Buch.

P. G. t. 8. f. 76.

The difference between this species and the variety which I have called *O. leucus* is very slight, the latter having but two rays less in the anal. All the other characters being nearly the same, I am in some doubt as to the propriety of regarding them as distinct species.

## II.—OPSARIUS LEUCERUS, J. M.

t. 47. f. 3.

This is a bright silvery species, very common about Calcutta, with the lower lobe of the caudal longer than the upper. The body above is straight from the apices of the jaws to the caudal fin, the lower margin is gracefully arched from the apex of the lower jaw, so as to form the deepest part of the body under the pectorals, which are long and falciform, and covered above their insertion by a scaly appendix. The fin rays are,

$$D.9 : P.13 : V.9 : A.14 : C.\frac{9}{5}$$

The scales are very minute; the stomach is short, thick, and pyriform, terminating in a short muscular intestine which extends straight to the vent.

Some of the ponds near Calcutta contain vast numbers of this species. After the first fall of rain that took place in June last, when the surface had been parched and dry for several months, I was surprised to see a number of persons fishing in the trenches of the Esplanade, which at first seemed to be quite unconnected with any ponds from which the fish could have come, but on inquiry, I found that they had ascended to the drains from a reservoir at some distance, from which the fish must have had a fall of several feet to surmount.

## III.—OPSARIUS PHOLICEPHALUS, J. M.

t. 47. f. 2.

*Cyprinus gora*, Buch. P. G. p. 263.

Crown covered with scales; minutely serrated and sharp abdominal margin; sides silvery without spots, lateral line descends to the lower third of the abdomen. Pectorals long, ventrals very small. Muscular structure of the

back continuous over the nape to the snout, suborbital plates all of equal breadth, hook or knob on the apex of the lower jaw prominent; dorsal opposite to the ventrals. The fin rays are,

D.9 : P.13 : V.8 : A. 17.

In form this species is not unlike *Opsarius leucerus*.

IV.—OPSARIUS ALBULUS.

t. 48. f. 10.

*Cyprinus phulo*, Buch. Op. Cit. 262.

*Cyprinus phulchela*, id. Coll.

A small species found in the ponds in the north-western parts of Bengal; like the last the sides are silvery without spots or bars. The fin rays are,

D.9 : P.11 : V.8 : A.20 : C.18.

Dorsal placed opposite the ventrals.

V.—OPSARIUS CIRRATUS.

t. 56. f. 5. β.

*Cyprinus shacra*, Buch. Op. Cit. 271.

Head thick, and less compressed than the body. Pectorals low, and situated at a considerable distance behind the branchial aperture. Brachial plates broad, and a flat space below under the base of the pectoral fins; scales very small; suborbital plates of nearly equal breadth behind as below the eyes; rays of the branchial membrane large and strong. Several



short transverse bars on the sides; four cirri; caudal yellow, stained with black; brachial plates exposed and broad. The fin rays are,

D.9 : P.13 : V.9 : A.10 : C.20.

Found by Buchanan in the Kosi river, and in Upper Assam by Captain Hannay; it usually grows to four or five inches in length.

VI.—OPSARIUS FASCIATUS.

t. 48. f. 9.

*Cyprinus barna*, Buch. Op. Cit. 268.

*Cyprinus balibhola*, id. Coll.

Depth equal to a third of the length of the body, exclusive of the head and caudal; head deep and compressed, mouth horizontal. Eleven transverse green bands on each side; about forty-two scales along the lateral line; rays of the dorsal widely separated; fins strong, but pellucid. Fin rays arc,

D.9 : P.13 : V.9 : A.12 : C.19.

This species has been found by Buchanan in the extreme branches of the Ganges, in the Jumna, as well as in the Bramaputra; it attains three inches in length, he observes, and is often found in shallow waters on sand banks.

VII.—OPSARIUS MACULATUS.

t. 47. f. 4.

*Cyprinus tileo*, Buch. Op. Cit. 276.

Length of the head to that of the body as one to four, depth of the body equal to a third of the length, sides marked with several rows of green spots, mouth large, lower jaw sharp at the apex, and received into a notch on the

upper jaw: intermaxillary fixed, suborbital plates broadest below the eyes, brachial plates broad, and extend obliquely backward and downward, terminating in a rounded point on either side over the base of the pectorals. Pectorals and ventrals small, sides silvery, back green, caudal tipt with black, lower lobe longer than the upper. Fin rays are,

$$D.9 : P.14 : V.8 : A.15 : C.\frac{8}{10}.$$

Stomach strong and muscular, intestine consists of a short muscular canal extending straight from the pylorus to the vent.

#### VIII.—OPSARIUS BRACHIALIS,

t. 48. f. 6.

This is probably only a variety of the last. The suborbital plates are very narrow behind the eyes and broad below, on which account the head is short and deep. The pectoral fins are also placed very low down, and considerably behind the operculum; but the fin rays are nearly the same as those of the last species, and the sides are similarly marked, so that it is doubtful whether the slight diversity of form between the two can be considered of sufficient consequence to render them distinct species. The jaws are narrow, but the gape is wide, and when taken out of the water the jaws are usually much distended.

#### IX.—CYPRINUS BENDELISIS, Buch.

*Jour. Mys.* vol. iii. p. 32, P. G. p. 270.

This species though described in both the works of Buchanan above referred to, does not appear to be found in any other part of India than Mysore, unless its place in the Gangetic Fishes be taken as evidence of its being

found in Bengal. It appears to differ from *Opsarius cirratus* in having larger scales, but the markings and fin rays in both are alike, which made me at one time mistake the latter for *Cyprinus bendelisis*.

X.—OPSARIUS GRACILIS, J. M.

t. 47. f. 1.

*Cyprinus goha*, Buch.

*Korang*, of the Assamese.

The length of the head to that of the body is as two to five, the body is long and slender, covered by minute scales; the mouth is widely cleft, and horizontal, extending behind the eyes, which are placed in the anterior third of the head. The dorsal fin is placed over the space between the ventrals and anal; the pectorals are of moderate size, the ventrals small. The fin rays are,

D.10: P.13: V.9: A.12: C.18.

One or two irregular bars of round green spots on each side; sides bright, and silvery white; the back is green, and slightly, but uniformly, raised in the middle. The body is moderately compressed, and the dorsal and ventral margins extend uniformly over the head to the apices of the jaws, which are placed in the axis of the vertebral column; the apex of the lower jaw is armed with a prominent blunt knob.

One of the most peculiar characters, perhaps, of this species, consists in the third suborbital plate representing the corresponding bone of the suborbital chain in the Perch, being expanded, and extended backward behind the eye, causing a remarkable elongation of the head, as in some of the Barbels, especially *B. megacephalus*. Yet considering the wide interval between these groups, we cannot look upon this peculiarity otherwise than a relation of analogy, similar to that which the compressed and

smooth abdomen of the two first species of this group presents to the narrow serrated abdominal ridge of the *Clupeidæ*.

The stomach is equal to about half the entire length of the animal, and the intestine from the stomach to the vent only about half the length of the stomach itself, and separated from that organ, which it rivals in capacity, merely by a stricture.

The liver and other large glands whose functions are supposed to facilitate digestion are extremely small in this species, though it is possessed of an insatiable carnivorous appetite; nor have I found in *Cyprinidæ*, in general, those glands bear any proportion to the size of the stomach, or the nature of the food in different species.

This species occurs in all parts of Assam, in the Kosi, the Jumna, the Ganges, and the Soane rivers; in which last Buchanan says it attains the size of a Herring, and is called Trout by the English, chiefly from the spots on the sides, and its fine flavor. For the latter I cannot answer; but as the species of this group are not much esteemed by the natives, I suspect it owes its imagined sweetness, in some degree, to its supposed resemblance to Trout. Notwithstanding the beauty of its appearance, its habits are such as to render it very objectionable in fish ponds.

#### XI.—OPSARIUS MEGASTOMUS.

t. 48. f. 5.

*Cyp. bola*, Buch.

Mouth large, several transverse green bars and a yellow longitudinal streak on either side: the suborbital plates are elongated posteriorly; apex of the lower jaw sharp, and received into a notch in that of the upper jaw, which is longer. The fin rays are,

D.10: P.16: V.9: A.11: C.19.

This species was found by Buchanan in the Bramaputra, where he says it grows to four or five inches in length, and is little valued.

XII.—OPSARIUS ISOCHEILUS.

t. 56. f. 1.  $\beta$ .

*Cyp. vagra*, Buch. Op. Cit. 269. *Cyp. loya*, id. Coll.

A well formed, handsome species, with a small head; jaws of equal length; intermaxillaries protractile; depth of the body equal to about one-third of its length; the sides are silvery, and marked by a row of small oblong spots placed transversely; the mouth is cleft to the eyes. Fin rays are,

D.9: P.13: V.9: A.14: C.16.

Forty-two scales along the lateral line, and ten in each oblique row from the base of the ventrals to the dorsum. Brachial plates exposed behind the branchial aperture. Found by Buchanan in the Ganges at Patna.

The rays of the caudal being so generally nineteen, I am in some doubt as to their being only sixteen in this species, as observed by Buchanan.

In two small collections of fishes received from very opposite parts of India—Upper Assam and the heights on the Western-side of Bengal, for which I have been indebted to the kindness of Captain Hannay and Dr. Macleod—I find a species which, with the exception of having the usual number of caudal rays, differs but slightly from the above.

The following are its characters—forty-four scales along the lateral line, and eleven from the base of the ventrals to the dorsum, nine bars or transverse spots on the back.

D.9: P.12: V.9: A.11: C.19.

HABITAT.—Hazarebaug, and Upper Assam.

## XIII.—OPSARIUS ANISOCHEILUS.

t. 48. f. 8.

*Cyp. barila*, Buch.*Cyp. chedrio*, id. Loc. Cit.

Silvery sides, with a row of incomplete bars or oblong transverse spots on each; the deepest part of the body would seem, according to Buchanan's figure, to be about the situation of the pectorals; the head is shorter, and blunter than has been observed in preceding species, and the lower lobe of the caudal is longer than the upper. Buchanan states "the upper jaw is the longest, and is entire at the end," though it would appear to retain the other essential characters of Opsarions. Fin rays are,

D.8 : P.14 : V.8 : A.13 :

This species was found by Buchanan in the northern parts of Bengal; *Cyprius chedrio*, Buch. would appear to be the same, having one additional ray in the dorsal.

## XIV.—OPSARIUS ACANTHOPTERUS, J.M.

t. 48. f. 7.

*Balisundree* of the Assamese.

The specimen having been lost from my collections before I could make either the necessary corrections of the figure, or of the description, both are to be received with doubt.

Mouth large, suborbital plates broadest beneath the eyes, greenish yellow on the back, with a red blush on the other parts of the body,

sides crossed with green bars, dorsal opposite to the ventrals, contains nine rays and is preceded by a short detached spinous ray ; the first rays of the pectorals separated by a broad expanse of the membrane of the fin.

The alimentary canal of this curious species is long and convoluted in circles round the cavity of the abdomen ; the coats of the stomach and intestines are soft, so as to separate on the slightest touch of the forceps, and the contents are dark coloured ; the air-vessel is long, and divided into two cells, the first small and globular, the posterior cell long, and conical. Although there is something doubtful about the habits of this species which, notwithstanding the length of the intestines is said by the natives to be carnivorous, I have ventured to place it conditionally in this genus.

### III.—SUB-FAM.—APALOPTERINÆ, J.M.

This sub-family comprises the Linnæan genus *Cobitis*, the *Paccilia* of Schneider, *Cyprinodons* of Lacepede, and two other small genera recently discovered in India.

They are distinguished as a natural group from preceding sub-families by their slightly compressed bodies covered with a thick slimy mucous, by the uniform softness of all the rays of their fins, and the peculiarities of the head and branchial membrane, as well as by the circumstances attending the air-vessel, which in some is wanting, in others encased in a bony cell, in others divided by a longitudinal septum.

The diversified character of the group may well entitle it to the denomination aberrant, independent of the sense in which that term is strictly employed by writers on natural classification.

Apart from the principles which those writers have laid down, it would be difficult, if not impossible, as indeed it has proved to the greatest comparative anatomist of modern times, to arrange according to their natural relations

the seven artificial genera which he has attached as so many dislocated appendages to a single artificial genus, *Cyprinus*, in the Regne Animal.

The length of this paper now compels me to take a rapid survey of the remaining divisions of the family. The first observation that here presents itself, is the very close connexion of the *Pæciliæ*, the *Lebias funduli*, and *Cyprinodons*, which in the Regne Animal form so many distinct genera, in consequence of a variation in the number of rays in the branchial membrane, while in all other respects they closely correspond. Were the branchial rays alone to direct us in the formation of groups, it is evident the Loaches, which all have agreed to be distinct, should be embodied in one genus with the *Sarcoborinae* and *Pæonominæ*. Since it would be obviously wrong to unite such opposite forms in one group merely because they correspond in the number of branchial rays, it must be equally so to separate other forms which are closely allied because their branchial rays differ. I therefore propose to distinguish all the small groups in question by the following character:—

#### PÆCILIANÆ.

*Head flattened, with minute teeth inserted along the edges of the jaws, caudal entire, from four to six rays in the branchial membrane.*

We should then have the following sub-genera forming one natural group:—

- 1 *Pæcilia*, prop. Schn. Five rays in the branchial membrane, jaws protractile, with a single row of teeth.
- 2 *Lebias*, Cuv. Teeth hooked, jaws protractile.
- 3 *Aplocheilus*, J. M. Teeth as in the *Pæcilia*, intermaxillaries fixed.
- 4 *Fundulus*, Lacep. } Four rays in the branchial membrane, teeth crowded.
- and }  
5 *Molinesia*, Leseur. }
- 6 *Cyprinodon*, Lacep. Six rays in the branchial membrane.



The first sub-genus is peculiar to the rivers of America, the third is only found in India, and the remainder are common to Europe and America.

The *Platycaræ*, Pl. 49, form the next genus; in these the head is also flat, with the eyes placed on the upper surface, as in the *Siluridæ*; but the mouth is small, without teeth, and soft. The alimentary canal is however short, as in carnivorous species; their pectorals are round, and sometimes placed on fleshy pedicles or arms, with but two rays in the branchial membrane. This remarkable genus corresponds with the natatorial type, to which I conceive the *Pæcilinæ* also belong, notwithstanding their small size.

The *Psilorhynchi* follow the last in the order of their affinities; in these the snout, rather than the head, is flattened, and much elongated in front of the mouth, which is remarkably small. This genus connects the Loaches with the *Platycaræ*, and affords the suctorial type, as will be seen from the descriptions (and figures, Pl. 50) of the only two species yet met with.

To these last the Loaches follow. I have already stated my reasons for having arranged them according to their colours and form of the caudal; I shall now merely notice one or two points on which their typical characters seem to rest. In this group the suborbital plates are transformed into spines, which are fixed by an articulation to a process of the frontal bone in front of the eye, so as to be raised at pleasure as organs of defence, like the horns of Ruminants; at other times these spines are lodged in a suborbital sinus, similar to that of the *Cervidæ*. Of the two sub-genera into which I have divided them, the true Loaches, or those with the caudal entire, appear to be the more terrestrial, in consequence of the rudimental character of the natatory bladder, or, of its total absence in many of the species; while in some of the *Schisturæ*, or those with bifid caudal, there is an abdominal air-vessel enabling the species possessed of it to frequent the deepest waters in the largest rivers, while the true Loaches are generally found in creeks and jeels, and would thus appear to present a closer relation to *Apodal* fishes;

the former therefore close the circle of the family by their union with the Cirrhins. Having thus pointed out the leading divisions of the *Apalopterinae*, I shall now proceed to notice our Indian examples of its component parts in detail.

Of the *Paciliana* we have only in India the

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SUB-GEN.—APLOCHEILUS, J. M.

This sub-genus has the head flat and broad, with the eyes placed on its edges, the mouth directed upwards, and a single row of large teeth inserted along the edges of the lips, which are not protractile as in *Pacilia propria*, Schn. They have five rays in the branchial membrane, the fins thin and transparent, and the caudal entire. A short dorsal is placed near the extremity of the tail and opposite to a long anal; the ventrals are very small, and the intestine and stomach form together a small tube, scarcely longer than the body. Two species are found in the ponds in Calcutta, and were first pointed out to me by my friend Mr. Griffith, in vessels of water in which he kept *Confervæ* for botanical purposes.

I.—APLOCHEILUS CHRYSOSTIGMUS, J. M.

. t. 42. f. 2.

Little more than an inch in length, with a bright gold-like spot on the occiput, and another in front of the dorsal; about twenty-eight scales along the lateral line, and nine rows between the ventrals and dorsum; caudal entire, and lanceolate behind. The fin rays are,

D.7 : P.13 : V.—? A.17 : C.18.

The stomach is large, and with the intestine forms a short conical canal about two-thirds of the length of the body.

II.—*APLOCHEILUS MELASTIGMUS*, J. M.

t. 42. f. 3.

Somewhat less than an inch in length, with a black spot at the root of the dorsal, teeth small, and crowded at the sides of the mouth, with the outer row slightly hooked, caudal entire, and rounded behind. The fin rays are,

D.7 : P.10 : V.—? A.22 : C.18.

Alimentary canal as in the preceding species.

II.—GEN. *PLATYCARA*, J. M.

*BALITORA*, Gray.

The head is flat, with the eyes placed on its upper surface; the fins are thick, opaque, and supported by soft and feeble rays; the pectorals are large, round, and broad, placed on fleshy pedicles; the anal is small; the dorsal opposite the ventrals; the body long and not compressed; the tail is long and the caudal bifid; mouth soft, small, without teeth, and placed on the lower surface of the head. Three species only are known, and two of these are figured in Hardwicke's Illustrations, but from their forming a distinct type I have taken the liberty of introducing their figures to this paper.

I.—*PLATICARA MACULATA*.

t. 49. f. 2.

*Balitora maculata*, Gray, Hard. Illust.

t. 88. f. 8.

Prominent, loose, flacid abdomen, obscure and irregular brown spots on the sides, two small interrupted bars on the caudal, scales rather large, fins except the anal and caudal, round. The fin rays are,

D.8 : P.17 : V.9 : A.6 : C.19.

The stomach and intestine form a continuous fleshy tube not much longer than the body. The specimen from which this description was taken was brought from the Boutan mountains by Mr. Griffith, but was too much decayed to admit of a fuller description.

II.—*PLATYCARA NASUTA*, J. M.

t. 57. f. 2.

This species was found in the Kasyah mountains by Mr. Griffith, to whom we are indebted for so many similar accessions. The snout is abruptly depressed between the eyes, with a large pit between the nostrils; body strong and sub-cylindric; about thirty-four scales along the lateral line, and eight in an oblique row from the base of the ventrals to the dorsum. The fin rays are,

D.10 : P.16 : V.9 : A.6 : C.15.

Length six inches.

*Balitora brucei*, Gray, Hard. Illust. t. 88. f. 1.

t. 49, f. 1.

Of this species I know no more than is conveyed in the apparently excellent figure given in Hardwicke's plates; it seems to differ from the first in having still broader pectorals and ventrals, and in all the fins being crossed by obscure bars, which might have suggested a more appropriate name than that bestowed on it by Mr. Gray.

III.—GEN. *PSILORHYNCHUS*, J. M.

Muzzle elongated and flattened, eyes placed far back, opercula small. mouth small and suctorial, without cirri, fins as in the *Gonorhynchi*, but more elevated.

I am indebted for this genus to two drawings in Buchanan's collection, named by the author *Stolephorus sukati*, and *S. balitora*.

Now the *Stolephore* or *Engraulis*, Cuv. (Anchovies) belong to the *Clupeidæ*, to which the depressed form, and short anals of these species render it impossible that they could belong; and Buchanan seems afterwards to have corrected the mistake, as the species in question appear to me to be described in the Gangetic Fishes as *Cyprinus sucatio*, Buch. and *Cyprinus balitora*, id.

The typical character of these species depends on the extreme prolongation of the snout in front of a remarkably small soft mouth, which is without cirri.

The defenceless body, the backward position of the eyes, the well formed and fully developed fins, indicative of rapid powers of motion, are also analogical relations to the suctorial types of other classes. We are not acquainted with the habits of the species in question, and can only say that they were obtained in the north-eastern parts of Bengal, to which they have been probably swept down from the mountains.\*

#### I.—*PSILORHYNCHUS SUCATIO.*

t. 50, f. 1.

*Cyp. sucatio*, Buch. *Gan. Fis.* 347,

*Stolephorus sukati*, id Coll.

Pectorals round, snout depressed and elongated in front of the mouth, which is small, with fleshy protractile lips; apertures of the gills small, belly flat. The fin rays are,

D.9 : P.13 : V.9 : A.5 : C. 16.

Said to have a strong resemblance to many of the genus *Cobitis* both in form and colour, but wants cirri.

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\* Since the characters of these interesting species noted in the synopsis were printed, together with other remarks regarding the singular forms of the two species figured by Buchanan, I have been fortunate enough to find a single specimen of one of them in a small collection of fishes with which I have been favoured from Upper Assam by Capt. Hannay.

II.—*PSILORHYNCHUS VARIEGATUS.*

t. 50. f. 2.

*Cyp. balitora*, Buch. Op. Cit. 348.*Stolephorus balitora*, id. Coll.

The following characters derived from the Assam specimen, differ little from those given by Buchanan, except that the rays of the pectorals are seventeen in each fin, instead of twelve as stated by Buchanan with doubt. The colours are,

Silvery below, above spotted; one row of cloud-like spots along the back, and another on each side; thirty-three scales along the lateral line, and about eight across the body from the base of the ventrals to the dorsum; three bars on the caudal. The fin rays are,

D.10 : P.17 : V.9 : A.7 : C.18.

Stomach hard and round, intestines small, and about half the length of the body.

HABIT.—Rapids at the foot of mountains.

## IV.—GEN. COBITIS. Lin.

The Loaches are very numerous in India; Buchanan describes thirteen species, and Mr. Griffith's and my own collection in Assam make us acquainted with seven more.

The caudal fin appears to afford the only natural character by which they may be separated; of this I have taken advantage, and find that in addition to the entire caudal, the colours of the true Loaches consist of different shades between brown and yellow, more rarely green; but whatever the colour may be, it is usually disposed in dots accumulated in clusters or nebulae on the

upper part of the body (Pl. 51 and 52), while the *Schisturæ*, or those with bifid caudal, have their colours, usually different shades of green, disposed in numerous rings or transverse bars distinctly marked on the sides.

In their digestive organs, the true Loaches (*Cobitis prop.*) assimilate nearer than the *Schisturæ* to the preceding genera; the stomach is small, and slightly curved or lunate, so as to place the pyloric orifice in front, and the intestine is either convoluted slightly or straight, according as the stomach may happen to be distended; but the whole length of the alimentary canal does not exceed half that of the body.\*

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\* The observation of Mr. George Daniell communicated to Mr. Yarrell, British Fishes, p. 379. of two spherical bony cavities placed under the first and second vertebrae, seem to me to be nothing more than the bony bilobate case enclosing the air-vessel, as pointed out by Schneider Syn. Pisc. Arted. 5 and 337. Professor Weber, according to Blumenbach, Comp. Anatomy, p. 285, found a connection between the air-vessel and ear of fishes by means of a chain of small bones analogous to the *malleus*, *incus*, and *stapes*, of *Mammalia*. These *ossicula auditus* occupy the situation of the bilobate case in the Loaches. What strengthens the probability of a connection between the air-vessel and ear of fishes, and destroys the idea of the situation of the air-vessel in the Loaches being so peculiar as Mr. Swainson supposes (Nat. Hist. Fishes vol. i. p. 362) is, that it is found in precisely the same situation in several of the *Siluride*, according to the interesting observations of Dr. J. Taylor, Gleanings in Science, Calcutta, June 1830. "The air-vessel," says Dr. Taylor of the *Pimelodus gogora*, *P. bagarius*, *Silurus singio*, *Macropteronotus magur*, Buch. "is placed behind the head, close to its articulation with the first vertebra; and in this situation is connected with the *ossicula auditus* which are conspicuous, and present the same appearance as those of the *Silurus boalis*." Dr. Taylor then enters into a very minute anatomical description of the part in question in each of the four species. In the first, it is situated in a bony cup attached by means of a narrow neck to the body of the first vertebra close to its junction with the cranium, and consists of two distinct air-bladders, which have no communication with each other. In the second species the air-vessel is also bilobate, but the lobes are situated on opposite sides of the vertebra. In the two last the air-bladders are also double, consisting of two lobes of pyriform shape, united at their narrow extremities, and continued in a funnel-shaped case projecting outward from the body of the first vertebra. As the direct affinity of the Loaches to *Siluride*, is suggested by Mr. Swainson (Nat. Hist. Fishes, vol. i.) without, it would seem, being aware of the singular agreement in the curious points of structure

In the *Schisturæ* the stomach is also lunate, but there is one or two convolutions of the intestine on its surface, and the alimentary canal is somewhat longer, equal to about the length of the body.

M. Agassiz, Mr. J. E. Gray, and Mr. Swainson, have divided the old genus *Cobitis* according to the presence or absence of suborbital spines, retaining the term *Cobitis* for the spineless, and each proposing a separate name for the spined Loaches. I have already observed, that I have sought in vain for other characters that might justify a division so simple and obvious; the result is, that I find it quite untenable, since it separates species otherwise most intimately allied to each other; while, on the contrary, it brings the most opposite forms together. No two species bear a more marked impress of one common genus than *Cobitis oculata*, t. 51, f. 1, and *Cob. puvonacea*, t. 52, f. 1., yet the one has suborbital spines, and the other is without them. No two species look less likely to be members of the same natural group than *Cobitis dario*, Buch. P. G. t. 29, f. 95, and *Cob. cinnamomea*, t. 51, f. 5; yet both have suborbital spines — both would belong to M. Agassiz's genus *Acanthopsis*, to Mr. Gray's genus *Botia*, and to Mr. Swainson's *Canthophrys*, which are all names for the same thing.

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alluded to, it is reasonable to suppose that this newly detected relation between *Siluridae* and *Cobitine* will be received as confirmation of Mr. Swainson's view, which may be further supported by the form of the air-vessel in those Loaches in which it is membranous, and placed in the abdomen, as *Cobitis dario*, Buch.; for neither in that species, nor in any of the *Siluridae* which I have examined, is it divided by a stricture as in *Cyprinidae*,

But notwithstanding the relations here pointed out between the Loaches and *Siluridae*, the bones of the shoulder, the bones of the head, and the spines, and covering of the body in the two groups, seem to prove that the relations between them are those of analogy, while the absence of teeth, the presence of scales and soft fins, indicate an affinity of the Loaches to the Cyprins, which has induced nearly all authorities on the subject since the time of Artedi to place them contiguous to each other, until Cuvier at length comprised them under one common family.



## SUB-GEN.—COBITIS PROPRIA, J. M.

Head and body elongated, the former conical and invested with a thick fleshy covering. Body almost cylindric, with small scales; a clouded distribution of plain colours, often brown; caudal entire, mouth small, placed below a narrow fleshy snout, and surrounded with small cirri. No abdominal air-vessel.

## 1.—COBITIS OCLATA, J. M.

t. 51. f. 1. β.

*Cobitis gongota*, Buch.

This species, like most of the Loaches, has six cirri. The eyes are prominent and raised above the crown; pectorals, ventrals, and caudal round; the branchial membrane is attached to the pectoral fins, as in the *Gobes*; body long, and marked with clouded spots of yellowish brown colour; dorsal and caudal crossed with interrupted fine bars or spots; colour above brown, below silvery. The fin rays are,

D.11 : P.10 : V.7 : A.7 : C.16.

Buchanan makes but six rays in each ventral, and eight in the anal fin. It has two suborbital spines on either side; the stomach and intestine are continuous and straight, and about half the entire length of the body. The lower jaw is composed of two very slender bones attached together in front by ligaments, and the air-vessel is contained in a small bony case situated over the entrance to the œsophagus. It is common in small stagnant streams with sandy bottoms in Upper Assam, and Buchanan found it in the northern parts of Bengal near the foot of the mountains; its usual length is about six inches.

## II.—COBITIS CUCURA, Buch.

t. 51. f. 2.  $\beta$ .

This beautiful little species, which is named *Chota kukura* by the natives, has also six cirri, and two suborbital spines. The sides are clouded with black along the lateral line, brown above, and below silvery ; all the fins but the anal are rounded, and the eyes are prominent. The fin rays are,

D.9 : P.9 : V.6 : A.7 : C.15.

It appears to be very nearly allied to *C. oculata*. It was found by Buchanan in the northern parts of Bengal, where it attains three inches in length.

## III.—COBITIS GUNTEA, Buch.

t. 51. f. 3.  $\beta$ .

This species has two cirri in front of the mouth, and four at its angles ; two suborbital spines on each side, and a nebulous stripe of copper colour extends along the lateral line ; colour above olive, below diaphanous, but clouded with dots collected in clusters, with a tinge of green on the opercula, all the fins except the anal rounded. The fin rays are,

D.8 : P.8 : V.7 : A.7 : C.17.

Rays of the caudal and dorsal spotted with olive, those of the lower fins with dark metallic colour. It is very common throughout Bengal and Assam.

## IV.—COBITIS BIMUCRONATA, J. M.

t. 51. f. 5.  $\beta$ .*Cobitis botia*, Buch.

. This species has six cirri, with a single suborbital spine on each side. The body is nebulous green above, below silvery, and somewhat diaphinous. The fins are angular, the dorsal and caudal ornamented with spots. The fin rays are,

D.14 : P.13 : V.8 : A.8 : C.15.

This species was found by Buchanan in the rivers in the northern parts of Bengal.

## V.—COBITIS CINNAMOMEA, J. M.

t. 51. f. 5.  $\beta$ .*Cob. pangia*, Buch.

This very remarkable species is long, and almost quite cylindric; it has eight cirri with prickles under the eyes, and the whole is a light cinnamon colour; the height of the body is equal to about a tenth of the length; the fins are round and small, the dorsal opposite to the interval between the anal and ventrals. The fin rays are,

D.7 : P.10 : V.6 : A.7 : C.18.

This species was also found in the north-eastern parts of Bengal by Buchanan, who says it attains the length of three or four inches.

The remaining species are without suborbital spines.

## VI.—COBITIS OCELLATA, J. M.

t. 51. f. 6.  $\beta$ .*Cobitis biltura*, Buch.

This species has four cirri in front, and two at the angles of the mouth. It has small eye-like spots on the base of the caudal and dorsal fins; colour above brown, disposed in nebulous spots, and bars on the caudal, below silvery; ventrals lanceolate. The fin rays are,

D.14 : P.14 : V.8 : A.7 : C.19.

This species was found by Buchanan in the Bramaputra, and is very nearly allied to the following—

## VII.—COBITIS GIBBOSA, J. M.

t. 52. f. 7.  $\beta$ .*Cobitis turio*, Buch.

This species differs very slightly from the last; the back however is more abruptly arched, and the dorsal is much smaller at the base of the caudal; there is an ocellated spot on either side; colour above yellow, with nebulous streaks, below silvery; pectorals and ventrals lanceolate. The fin rays are,

D.8 : P.12 : V.8 : A.7 : C.19.

Two cirri are attached to the corners of the mouth, and four to the upper jaw: found by Buchanan in the Bramaputra.

VIII.—*COBITIS PAVONACEA*, J. M.

t. 52. f. 1.

The body of this interesting species is long, low, and crossed by about twenty half bars of dark greenish grey on the sides, an eye-like spot on either side of the tail, similar to the moons of the peacock, but surrounded by a plain, though distinct colour; caudal and dorsal crossed by numerous bars. There are two cirri at the corners, and four in front of the mouth; the snout is somewhat flattened. The fin rays are,

D.17 : P.13 : V.9 : A.6 : C.20.

The stomach is of lunar form, with the concave margin placed in front, with the pylorus directed forward, and ending in an intestine hardly half the length of the body, and which, after making one short turn passes to the vent.

HABITAT.—Assam.

IX.—*COBITIS CHLOROSOMA*, J. M.

t. 52. f. 3.

Light green, clouded with dark olive green above the lateral line, fins tinged with red, dorsal and anal slightly barred, snout short, six cirri. The fin rays are,

D.11 : P.12 : V.8 : A.6 : C.18.

This species has been found in pools in the sandy beds of rivers in Upper Assam.

## X.—COBITIS MONOCERA, J. M.

t. 52. f. 2.

The length of the head to that of the body as one to four, snout somewhat flat, and armed with a slightly prominent spine. The body is uniformly greenish yellow, with a silvery lustre; the integuments covering the opercula tinged with green, caudal and dorsal streaked with numerous small brown bars. The fin rays are,

D.12: P.12: V.8: A.6: C.18.

The stomach and intestines of this species agree in form with those of *Cobitis oculata*; there is however some uncertainty in judging of the form of the stomach in these species, as I find this to depend partly on the quantity of ingesta contained in it. In a specimen examined after it had been for some time in spirits, the stomach was straight; in others which were examined fresh the pylorus was reflected forward; but in all, the intestine was found to be small and short. This species is not distinguished by the Natives from *Cobitis chlorosoma*, both of which they name *Bali botea*.

## XI.—COBITIS GUTTATA, J. M.

t. 52. f. 5. 6.

This species differs from the last two, chiefly in having but four cirri; the snout is soft, and the body dotted, green above and silvery below. There are but eight rays in the dorsal fin. The stomach and intestine form a straight continuous tube. The liver is large, and envelopes the stomach. It inhabits tanks in the vicinity of Joorhath.

## XII.—COBITIS PHOXOCHEILA, J. M.

t. 52. f. 4.

This curious species has the head raised obliquely as in the *Perilampus*, and the ridge between the eyes sharp and bony. Sides compressed, and a dark nebulous streak extends along the lateral line on either side. Above clouded with brown, beneath silvery. The fin rays are,

D.8: P.8: V.6: A.6: C.16.

The caudal is round, and crossed by several small bars. Found by Mr. Griffith in the Mishmee mountains.

## SUB-GEN.—SCHISTURA, J. M.

The species composing this sub-genus have hitherto been placed with the Loaches, with which their habits and form correspond; many of them have also similar suborbital spines to those of some of the true Loaches, and all of them have small scales, and the surface of the body enveloped in a copious mucous secretion like the Loaches, from which they are only known by their bifid caudal, and the transverse bars or rings of colour that encircle the body. This last remarkable character may be regarded as a remote analogy to the structure of annulose animals, to which these fishes approximate by means of the Lampreys and Mixines, which Linnaeus placed with the worms. The resemblance between the mouth of the Loaches and that of the Mixines is indeed so remarkable as to require only to be alluded to, in order to perceive the relation between the two groups.

The alimentary canal is somewhat longer than the body, the stomach is short and lunate, the pylorus reflected and supplied with a valve. A bilobate natatory bladder, divided by a longitudinal septum, is found in some of the most perfect species, as *Cobitis dario* and *Cobitis geta*, Buch. whose short

figure, arched back, and comparatively lengthened intestine, seem to conduct us back once more to the Cirrhins and other typical forms of the *Pæonominæ*. In order that this interesting fact may be conveniently seen by the reader, I have copied Buchanan's figures of the two species in question, Plate 61, f. 8 and 9, for the sake of comparison with the *Ruee*, Pl. 41. f. 2, and other Cirrhins.

It will be evident to the naturalist, or indeed any one who may condescend to reflect on the subject, that we could not consistently commence in this group by describing *Cobitis dario* and *Cobitis geta* immediately after *Cobitis guttata* and *Cobitis phoxocheila*, with which the last group ended, especially if we regard the order in which species are described as that in which their affinities pass from one to another. We must differ therefore in this instance from the usual practice of describing the most perfect species first, and we are compelled, whether we will or not, to commence with the most imperfect form, because it corresponds nearest in every respect with the form last described; and this appears to be a natural result, which must always be experienced in that group which closes a perfect circle of affinities.

I.—SCHISTURA MONTANA, J. M.

t. 57. f. 1.

This small species was discovered by Dr. Macleod in mountain streams in the vicinity of Simla. It is characterised by twelve zones or rings, which encircle the body, and with a black bar at the base of the caudal fin. It is furnished with a single suborbital spine on each side. The fin rays are,

D.8 : P.10 : V.8 : A.6 : C.18.

Dorsal and caudal each marked with a single row of spots; it is one of the most lengthened forms in the group.



●  
II.—SCHISTURA ZONATA, J. M.

t. 53. f. 1.

Without suborbital spines; the body is encircled by about eleven complete rings of green colour; opercula broad, naked, and silvery, fins pellucid, without dots,

D.11 : P.11 : V.8 : A.5 : C.17.

This small species was found in ponds in the Muttuc district in Upper Assam. The pylorus is reflected forward so as to form the stomach into a small lunate sac, on the surface of which two or three convolutions of the intestine take place; between the stomach and intestine there is a narrow stricture, probably a pyloric valve. Limbs of the lower jaw firmly united at the symphysis, as in the Gudgeons.

## III.—SCHISTURA RUPECULA, J. M.

t. 57. f. 3.

Without suborbital spines; there are about fourteen bars or zones encircling the body like those of the last; pectorals and ventrals round.

D.8 : P.10 : V.8 : A.7 : C.16.

This species was found by Dr. Macleod in the mountains in the vicinity of Simla, and is very evidently distinct from either of the adjoining species.

## IV.—SCHISTURA OCELLATA, J. M.

This is a different species from either of the accompanying, although it is difficult to make the real differences appear correctly either in drawings or descriptions. The fin rays are,

D.9 : P.12 : V.8 : A.6 : C.17.

It was found in stagnant pools in Upper Assam. The stomach is short with the pyloric reflected, intestine small, convoluted over the surface of the stomach, to which the convolutions are closely fixed in this as in several of the *Schisturae*; the length of the intestine is equal to that of the entire animal.

V.—SCHISTURA SAVONA.

t. 53. f. 3. β.

*Cobitis savona*, Buch.

Without spines, six cirri, four in front and two at the corners of the mouth, colour above dusky, with about ten narrow light coloured bands; below silvery. The fin rays are,

D.10: P.10: ? V.6: ? A.6.

Found by Buchanan in the Kosi river.

VI.—SCHISTURA PUNCTATA.

t. 53. f. 4. β.

*Cobitis corica*, Buch.

Without spines; six cirri, four in front and two at the angles of the mouth; a row of eleven spots along the lateral line on each side, and a similar row along the back; below silvery, above bluish; the whole however somewhat diaphanous. The fin rays are, according to Buchanan,

D.9: P.11: V.7: A.6: C.19.

or, as I have found them,

D.10: P.11: V.9: A.7: C.10.

## VII.—SCHISTURA SUBFUSCA.

t. 53. f. 5.

Without spines; four cirri in front of the mouth, various regular zones encircling the body; eyes approximating to each other on either side of a narrow trenchant ridge like that of *Cobitis phoxocheila*; snout hard. Fin rays arc.

D.11 : P.11 : V.7 : A.7 : C.17.

HABIT.—Upper Assam.

## VIII.—SCHISTURA SCATURIGINA.

t. 53. f. 6. β.

*Cobitis scaturigina*, Buch.

This species is also without suborbital spines, and in my opinion is nearly allied to *S. subfusca*; the ventrals are however round, and the rays of the dorsal are marked on the middle with a brown spot. I cannot find this species referred to in the Gangetic Fishes, although it is figured in Buchanan's collection.

So many divisions of the Loaches have been proposed, and so many names to designate those divisions, that I feel some doubt in recommending the generic term *Hymenphysa*\* for the following three species, which are distinguished from all others by the presence of an abdominal natatory bladder, separated into lobes by a longitudinal septum.

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\* Etym. ὑμεν, a membrane, and φυσσα, an air-bladder.

1.—*COBITIS DARIO*, Buch.

t. 61. f. 8. P. G. t. 29. f. 95.

Six cirri, two suborbital spines, body compressed, depth equal to about a third of the length, body crossed by about seven transverse green bands. Three or four interrupted green bands on the caudal. The fin rays are,

D.11 : P.13 : V.8 : A.7 : C.<sup>9</sup>/<sub>10</sub>.

Found in all the large rivers of Assam and Bengal, and attains eight or ten inches in length.

2.—*COBITIS GETA*, Buch.

t. 61. f. 9. P. G. t. 11. f. 96.

Eight cirri, two suborbital spines under each eye, and seven transverse bars of blackish green across the body, and one on either side of the head crossing over the eyes, and also two interrupted bars on the caudal. The fin rays are,

D.12 : P.13 : V.8 : A.8 : C.19.

Buchanan's variety of this species has but one bar on the caudal, nine rays in each ventral, and only seven in the anal fin. There are other trifling differences of colour between the Assam and Bengal varieties, but scarcely enough to induce me to regard them as distinct species.

3.—*BOTIA GRANDIS*, Gray.*Hardw. Illust—*

Body brown, with irregular and somewhat square yellow spots, fins streaked and spotted with brown, eight cirri. This is the only instance of a spotted species that I know of in this group, and ought to suggest a better name than that above applied to it.

A comparison of the *Schisturæ* as they appear plate 53, with the Loaches which immediately precede them, plate 52, will show that the latter present little resemblance to the typical forms of the great family to which they belong; indeed fig. 7, t. 52. is perhaps the only one on the plate that seems to indicate any resemblance whatever to the ordinary forms of Cyprins.

In the succeeding plate 53, we do see a somewhat nearer approach to the general forms of *Cyprinidæ*; figs. 8 and 9, plate 61, which in their direct affinities follow those species, represented plate 53, present a still closer relation to the Cirrhins, nor is this a mere resemblance of outer form, for in *Cobitis* and *Schistura* the natatory vessel is absent, or enclosed in a bony case which is situated over the throat. But that vessel is again restored to the genus in the two species represented plate 61, thus perfectly obliterating the interval by which the *Schisturæ* at one extremity of the family are removed from the Cirrhins at the other, and causing the two ends to meet, according to the law of natural affinities pointed out by Mr. W. S. Macleay.

#### DESCRIPTION OF PLATES LIX, LX, LXI.

The important use that has been made of the structure of scales of fishes by M. Agassiz, not only in the classification of fishes, but for objects of equal interest in another branch of science, must in future render any descriptions of fishes in which figures of the scales are omitted very incomplete. M. Agassiz in the prospectus of his forthcoming work on the natural history of the fresh water fishes of Europe observes, "Comme j'attache la plus grande importance aux caractères tirés de la forme des écailles, je n'ai point négligé d'en figurer trois pour chaque espèce, savoir, une de la ligne latérale, une de la région dorsale et une troisième de la région abdominale."

Before I was aware of the position and number of the scales selected by M. Agassiz for examination, most of the plates were finished; and to give separate ones of three scales from each species would have increased the bulk and expense of the paper beyond the measure of any equivalent advantage. The scales which are represented on the annexed plates were therefore selected from the posterior third of the body, about half way between the dorsal and caudal fins, where they appeared to bear the nearest relation to the general form of scales on other parts of the body. When a second scale is given, it has always been taken from between that situation and the dorsum.

#### PLATE LIX.

- Fig. 1. Scale of *Leuciscus daniconius*, Buch. from the lateral line.
- Fig. 2. Scale of *Leuciscus dystomus*, J. M. from the lateral line.
- Fig. 3. Scale of *Leuciscus morar*, Buch. from the lateral line.
- Fig. 4. A single scale of *Opsarius leucerns*, from the lateral line.
- Fig. 5. Scales of *Leuciscus mola*, *a* from the lateral line, *b* from between that situation and the back, *c* natural size.
- Fig. 6. A single scale of *Cyprinus baicala*, Buch.—*b* natural size.
- Fig. 7. A single scale of *Leuciscus margarodes*—*b* natural size.
- Fig. 8. Scales of *Leuciscus elingulatus*—*a* from the lateral line, *b* from between that situation and the back.
- Fig. 9. Scales of *Opsarius fasciatus*—*a* from the lateral line, *b* from between that situation and the back.

- Fig. 10. Scales of *Opsarius megacephalus*—*a* from the lateral line, *b* from between that situation and the back.
- Fig. 11. A single scale taken from the lateral line of *Opsarius maculosus*.
- Fig. 12. A single scale from the lateral line of *Opsarius brachialis*.
- Fig. 13. Scales of *Opsarius isocheilus*—*a* from lateral line, *b* from between that situation and the back.
- Fig. 14. Scales of *Opsarius cirratus*—*a* from the lateral line, and *b* from between that situation and the back.

## PLATE LX.

- Fig. 1. *Perilampus æquipinnatus*, J. M. natural size—*a* breadth of the body, *b* scale from the posterior third of the side a little above the lateral line which is very small.

The remaining figures of scales on this and the succeeding plate have been drawn from the microscope by my friend Mr. W. M. Westermann.

- Fig. 2. Scales of *Cyprinus curchius*, Buch.—*a* from the lateral line, *b* from between that situation and the dorsum, *c* and *d* natural size.
- Fig. 3. Scales of *Gobio bicolor*, J. M.—*a* from the lateral line, *b* from between that situation and the dorsum, *c* and *d* their natural size, *e* the manner in which they are placed.
- Fig. 4. Scales of *Gobio anisurus*, J. M.—*a* from the lateral line, *b* from between that situation and the dorsum, *c* and *d* natural size, *e* their disposition.

- Fig. 5. Scales of *Gobio isurus*, J. M.—*a* from the lateral line, *b* from between that situation and the dorsum, *c* and *d* natural size.
- Fig. 6. Scales of *Gobio ricnorhynchus*, J. M.—*a* from the lateral line, *b* from between that situation and the dorsum, *c* and *d* natural size, *e* the manner in which they are placed.
- 
- Fig. 7. Scales of *Gobio limnophilus*, J. M.—*a* from the lateral line, *b* from between that situation and the dorsum, *c* and *d* natural size, *e* the manner in which they are placed. In this species, as already remarked in the description, every row of scales has its own row of mucous pores the same as the lateral line, which last differs from the other rows merely in being a little more prominent.
- Fig. 8. Scales of *Cyprinus boga*, Buch.—*b* from the lateral line, *a* from between that situation and the dorsum, *c* and *d* natural size, *e* their relative position to each other. In this species, which may either be *Cyprinus boga*, *Cyprinus ariza*, or *Cyprinus pangusia*, of Buchanan, each row of scales is possessed of a line of mucous pores as in *Gobio limnophilus*.
- Fig. 9. Scales of *Gonorhynchus macrosomus*, J. M.—*a* from the lateral line, *b* from between that situation and the dorsum, *c* and *d* natural size.
- Fig. 10. Scales of *Gonorhynchus bimaculatus*, J. M.—*a* from the lateral line, *b* from between that situation and the dorsum, *c* and *d* natural size.
- Fig. 11. Scales of *Gonorhynchus brachypterus*, J. M.—*a* from the lateral line, *b* from between that situation and the dorsum.





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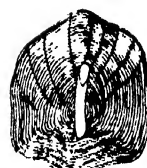
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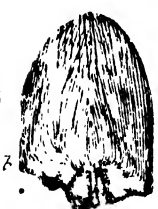
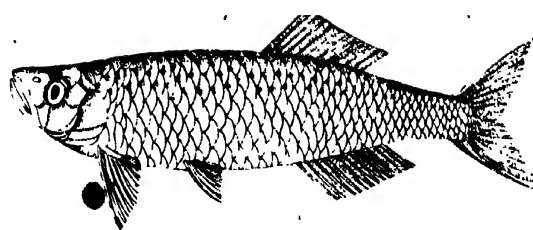


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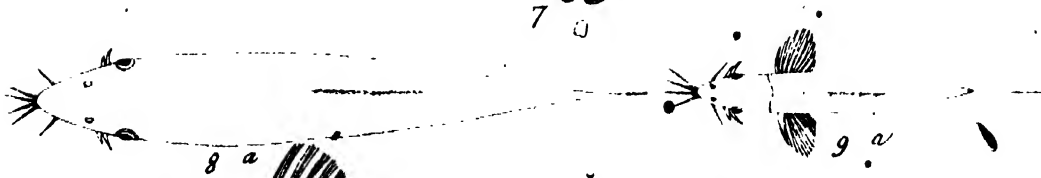
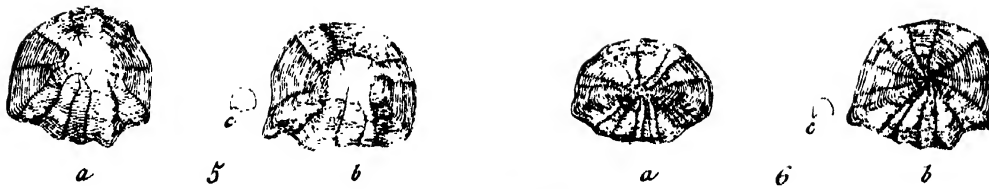
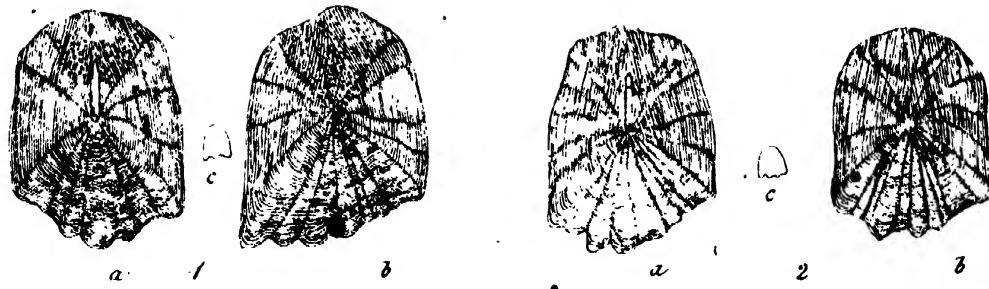
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11.









## PLATE LXI.

- Fig. 1. Scales of *Systomus chrysosomus*, J. M.—*a* from the lateral line, *b* from the interval between that situation and the dorsum, *c* natural size.
- Fig. 2. Scales of *Systomus immaculatus*, J. M.—*a* from the lateral line, *b* from between that situation and the dorsum, *c* natural size.
- Fig. 3. Scales of *Cyprinus sophore*, Buch.—*a* from the lateral line, *b* from between that situation and the dorsum, *c* natural size.
- Fig. 4. Scales of *Systomus pyropterus*, J. M.—*a* from the lateral line, and *b* from between that situation and the dorsum, *c* natural size.
- Fig. 5. Scales of *Cyprinus conchonius*, Buch. In this species the lateral line is very obscure, or altogether wanting;—*a* is a scale from the usual place of the lateral line, and *b* from between that situation and the dorsum, *c* natural size.
- Fig. 6. Scales of *Systomus malacopterus*, J. M. The lateral line in this species is also indistinct;—*a* is a scale taken from its usual position, *b* from between the usual position of the lateral line and the dorsum, *c* natural size.
- Fig. 7. A scale from the lateral line of *Oreinus progastus*, J. M.
- Fig. 8. *Cobitis dario*, Buch. Natural size, and,—
- Fig. 9. *Cobitis geta*, Buch. two species here introduced from the Gangetic Fishes, to show how the form of the Loaches returns to that of the Cirrhins. Thus they may be compared with f. 1. t. 37., fs. 1. 2. t. 38., fs. 1. 2. 3. t. 40., f. 2. t. 41.

It remains to express my obligations to those who have assisted the object of the foregoing paper.

To WILLIAM GRIFFITH, Esq., M. A. S. &c. Madras Medical Service, who aided me in my collections since 1835, and is still mindful of this though engaged in other services of higher interest to science, I have been indebted for many species hitherto unknown from countries only visited by himself, and which were preserved under difficulties and privations that would have deterred an ordinary naturalist from the attempt, especially in the midst of other occupations.

To B. H. HODGSON, Esq. M. A. S. &c. Resident at Nipal, I have been indebted for a small collection of Cyprins deposited in the Asiatic Society; and to W. M. WESTERMANN, Junior, Esq.—a name not unknown to science in connection with one of the richest cabinets of insects in Europe, am I indebted for the drawings of scales forming the last two plates.

To Doctor MACLEOD, Inspector-General of Her Majesty's Hospitals in Bengal, I have been indebted for several collections from different parts of India, comprising many species previously unknown.

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To R. B. CUMBERLAND, Esq. Bengal Medical Service, I am also indebted for a small collection of fishes from the Cuttack district: and, lastly—



I am indebted to the gracious consideration of the RIGHT HONORABLE GEORGE, LORD AUCKLAND, G. C. B. &c. not only for the opportunity of examining my collections of fishes, which had otherwise been denied on my return from Assam, but also for the inspection of the splendid collection of drawings of the late Dr. FRANCIS BUCHANAN HAMILTON, many of which, under Providence, I have been the humble means of submitting to the world.

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#### SUPPLEMENT.

Since this paper was presented, two important communications have been made in Europe on the subject of the Fresh-water Fishes of India. The first is a paper presented in December, 1838, to the Zoological Society of London by Colonel Sykes, descriptive of forty species inhabiting the rivers of the Deckan, including several new genera. As Colonel Sykes's paper has not yet appeared, it remains to be seen how far the fishes of Western India correspond with those of the Ganges, Bramaputra, and North-eastern tributaries of those rivers, from which nearly all Buchanan's species and my own have been derived. The second work just alluded to, embraces descriptions of sixteen species of fishes found by Baron Hügel near the source of the northern branches of the Indus, of which fifteen belong to the great natural family *Cyprinidæ*; these are all ably described and beautifully illustrated by M. von Heckel, an eminent German naturalist of Vienna,\* who anticipates some of the observations contained in the foregoing pages, as well as one new genus, *Oreinus*, of which M. v. Heckel describes ten species, all except one distinct from the three which I have met with. The curious circumstance of the absence of *Salmonidæ* in

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\* *Fische aus Caschmir, gesammelt und herausgegeben Von C. F. v. Hügel, beschrieben Von J. J. von Heckel, &c. &c. Wien, 1838.*

India, which I have observed upon, p. 262, also seems to have occurred to M. M. Hügel and Heckel, who observe that the *Cyprinidæ* have not only replaced the *Salmonidæ* in the rivers of India, but have also assumed much of their habits. In the Nile, they observe, we have few Cyprins, and in the rivers of Surinam and Brazils there are none; it is only in the rivers of India where Cyprins have replaced the Trouts, (*Forellen*) that the number of their species is so considerable (*Fische aus Caschmir*, p. 2.). The species described in the work alluded to as *Silurus lamyhur*, Heck. differs from *Silurus pabda*, Buch. in the eyes being nearer to the mouth; but in other respects it approaches, M. v. Heckel thinks, to *Silurus chinois*, Lacep; the colour is rusty brown, with a silvery glitter. The next two are Loaches, not far removed from the species I have described as *Cob. chlorosoma* and *Cob. guttata*. They are named by M. v. Heckel *Cob. marmorata*, and *Cob. vittata*. The first, he thinks, may be *Cobitis corica*, Buch. and the second is named *Gurua*, by the natives of Cashmeer. A fourth species described by M. v. Heckel is referred to the genus *Varicorhinus*, Rüppell, which would include those species I have described as Gudgeons when they happen to have two cirri; but as cirri are not characters to be alone relied on in the formation of groups, it is unnecessary to dwell on the value of this genus: those who wish to adopt it, have only to apply the term *Varicorhinus* to the five first species of *Gobio* I have described, namely, the *Mrigala*, the *Rewah*, *Curmuca*, *Reba*, and *Angra*. The one described by Heckel as *Varicorhinus diplostomus*, Fisch. Casch. t. xi., is a new species, somewhat resembling, as M. v. Heckel supposes, *Leuciscus doubla*, but the body is more cylindric, and less compressed than any previously known species either of India or Europe.

The sixth species of M. v. Heckel is referred to another nominal genus, *Labeobarbus*, Rüppell, which differs in nothing more from the genus *Barbus*, Cuv. than in a fleshy appendage to the apex of the lower jaw, as in *Barbus progencius*, J. M. t. 56. f. 3. The species given by Heckel as *Labeobarbus*

*macrolepis*, o. c. t. x. f. 2. appears to resemble very much a species figured in Buchanan's collection under the name of *Cyprinus tor*, which is however, according to Buchanan, a large fish, while Heckel's species is only five inches long. I now come to M. Heckel's new genus *Schizothorax*, Etym. Σχιζω split (*spalten*) θώραξ a shield (*panzer*), from a membranous gusset in front of the anal fin, thus separating the scales slightly on either side of the vent; a character which I have overlooked in my genus *Oreinus*. I regard this curious peculiarity as an indication of some remarkable function or analogy. When in addition to this singular structure the scales on either side of the anal are enlarged, as in all M. v. Heckel's species, the character may be conspicuous enough; but in the three species I have met with, the scales, as in most *Cyprinidæ*, continue to diminish progressively from the sides to the hinder part of the body, where they are smallest: the membranous cleft however is perceptible; I would therefore regard those species whose scales are not enlarged on either side of the anal cleft, as still belonging to the sub-genus *Oreinus*, especially as M. v. Heckel observes with regard to *Cyprinus Richardsonii*, Gray, which I had ranked with the latter group, that it agrees nearly with his *Schizothorax plagiostomus*, but as the great scales near the anal appear from the figure to be wanting, it cannot be included in that genus (see note, Fisch. Casch. p. 16). Instead of the sub-genus *Oreinus* being ranked under the head of the Barbels of Cuvier, as it stands in the preceding pages, it should now become a sub-genus of M. v. Heckel's new group, of which the following are the characters:—

#### SCHIZOTHORAX, Heckel.

Four cirri, one at each angle of the mouth and two at the middle of the maxillary bones: dorsal and anal short, the first preceded by a bony ray serrated behind; scales small; the latter part of the belly terminating in a membranous space, in which the vent is placed, bounded laterally by large scales, which also encircle the base of the anal fin.

Ten species of this genus are described by M. von Heckel, all of them found by Baron Hügel in the tributaries of the Hydaspes; M. v. Heckel forms them into three divisions, according to the structure and situation of the mouth and snout; but as these peculiarities, together with the dorsal spine, form their great distinguishing feature from all previously known groups they ought perhaps to have been stated in the essential characters of the genus, particularly as the species do not differ so much among themselves as to render the subdivisions proposed by M. v. Heckel of much consequence.

To enable the reader to identify the several species described by M. v. Heckel, I here subjoin a synopsis of them :—

1. *Schizothorax plagistomus*, Heck. Fisc. Casch.t. i. Snout blunt and wrinkled, mouth inferior, large and transverse; cheeks and snout perforated with numerous pores. Length  $8\frac{1}{2}$  inches.

2. *Schizothorax sinuatus*, id. o. c. t. ii. Head compressed and obtuse, mouth small, dorsal placed over the commencement of the ventrals; body spotted uniformly above the lateral line, below silvery. Length 8 inches.

3. *Schizothorax curvifrons*, id. o. c. t. iii. Snout placed in a line with the axis of the body, crown rounded prominently over the eyes; back spotted, as well as the dorsal fin. Length  $8\frac{1}{2}$  inches.

4. *Schizothorax longipinnis*, id. o. c. t. iv. Snout blunt, compressed and deep, corresponding with the axis of the body; anal fin long; body without spots. Length  $9\frac{1}{2}$  inches.

5. *Schizothorax niger*, id. o. c. t. v. Snout short, head depressed over the eyes, sides and dorsal uniformly spotted and dark. Length 9 inches.

6. *Schizothorax nasus*, id. o. c. t. vi. Snout below the axis of the body, back rather abruptly arched in front of the dorsal fin; back and base of the dorsal fin spotted. Length  $10\frac{1}{2}$  inches.

7. *Schizothorax Hügelii*, id. o. c. t. vii. Snout below the axis of the body, thick. Dorsal fin commences in the middle of the back, scales at the base of the anal fin very large; spotted along the back. Length 14 inches.

8. *Schizothorax micropogon*, id. o. c. t. viii. f. 1. Snout in the axis of the body, cirri very small, mouth small. Length 5 inches.

9. *Schizothorax planifrons*, id. o. c. t. viii. f. 2. Snout above the axis of the body, and somewhat recurved, crown depressed, cirri longer than in the others.

10. *Schizothorax esocinus*, id. o. c. t. ix. Snout placed in the axis of the body, head long, depressed; operculum terminates behind in a long angular process; mouth long, as in the ordinary Barbels, spots dispersed irregularly on the sides above the lateral line and on the base of the dorsal and anal fins.

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This last form approaches to the true Barbels, and the succeeding species described by M. v. Heckel as *Barbus diplochilus*, t. x. f. 1. is either an *Oreinus* or a *Gonorhynchus*.

It would really seem as if we intended to leave all that requires either intellect or observation to discover in the productions of India to our neighbours on the continent. It is true, Natural History is not a pursuit likely to enrich the individuals who follow it; but as calculated to direct the energies of a nation to practical objects, as well as to afford the best promise of new articles either for our luxuries or our wants, its claims are not to be despised.\* To be fairly rivalled in any pursuits where facilities

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\* It is not an uncommon thing with us, to witness the publication of journals, reports, travels, and books of various kinds devoted to new countries, without a single remark to show that the author of any of them seemed at all aware that the creation consists of any thing deserving of observation but himself and his kind. However excusable this may be in the mere tourist, it is hardly so in those who are supposed to have been selected for their presumed acquirements as Naturalists.

While we are thus indifferent to objects that should connect our names with the science of our country, the collections of M. Jacquemont, M. A. De Lessert, M. Von Hügel, and other distinguished foreigners are daily appearing, some under the auspices of Societies abroad, and others under that of foreign noblemen who devote their wealth to the promotion of science; so that, however the sciences of Europe may be expressed in the English language, those of India are likely to be found only in languages foreign to the English student. The Indian Education Committee, at whose door Buchanan's MSS. have so long lain, while ten thousand pounds a year have been expended by them in juvenile schools, should look to the situation to which they are soon likely to be reduced.

[ The attempt

are equal between the parties would be bad enough, but to be indebted to strangers for a knowledge of the productions of our own country, argues a fault somewhere, but where that fault lies it might be a delicate question to inquire, as I fear none of us would be altogether free from a share of the reproach. As far as *Cyprinidæ* are concerned, the preceding pages will afford any one an opportunity of comparing those which are here described with such as occur in his vicinity, and by thus endeavouring to complete the history of each species, we might soon become as well acquainted with Indian, as with European kinds.

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The attempt to carry a national system of education into effect by means of juvenile instruction, while the cultivation of those sciences on which national prosperity depends is neglected, as well as individuals who evince a capacity and desire for education, may be regarded as doubtful in every way. Children can hardly be made the objects of foreign education without exciting the jealousy of parents, which has a secret tendency in the opposite direction; besides, few profit by instruction received in childhood. For these reasons, I think, attempts ought to be directed to the extension of science, and to the instruction of those only who evince a desire and capacity for it. In plans conducted on such principles we could hear of no failures, every rupee laid out would have its effects, and leave something to show for it.

In France we have heard of education being superintended by Cuvier and the greatest members of the Institute, but in England we search in vain for the names of our philosophers in Kildare Street and British School Societies. Hence their failure; for who are so fit to direct the education of others, as those who have themselves displayed the highest proofs of cultivated genius. Although it would unquestionably be a loss to the world were our Herschels, Browns, Daltons, and Macleays to devote their attention to other objects than their own researches, yet their presence in the places alluded to, would inspire a confidence that must be wanting in any system of education emanating from bodies from which they are excluded.

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*On the use of Ichthyology.*

Utility will always be found to depend more on the degree of attention paid to any subject connected with science, than on the nature of the subject itself ; yet it is a common remark that this, or that, is important or frivolous, according as we happen to be acquainted with it. When we find any branch of science regarded as useless, we may be assured that, contrary to ordinary expectation, it will prove the most productive field we can enter. Science, indeed, can only be useful where it has been cultivated, and its principles worked out ; practical results will then follow in proportion to the pains taken to develop them.

The moral interest of Ichthyology having been sufficiently attended to throughout the preceding paper, I shall here pass it over, merely remarking, that in common with other branches of natural science it is calculated to improve the mind as well as the condition of society, while its cultivation need not interfere with any duty, public or private ; and few who are placed on our coasts, or on the banks of any of the noble rivers of India, who might not with amusement to themselves, and advantage to science, communicate many observations no where else to be collected regarding our indigenous species. The season of spawning, and places to which the various species resort for this purpose—their food—the kind of waters in which they thrive best—whether running or stagnant—with sandy or with muddy bottoms,—would be all points of great interest that might be settled by persons of no pretensions to a scientific knowledge of the subject.

With regard to the propagation of fishes, Mr. Yarrell remarks—that an acre of water will let in many parts of the continent where fresh-water fishes are in more request than in England, for more than an acre of land. In no part of the continent of Europe, however, can fresh-water fish be of so much im-

portance as in India, where most of the domestic animals which in Europe afford the principal food, as the ox, swine, poultry, &c. are rejected by a large proportion of the people.

Throughout the Mysore country, as well as in many of the western provinces, large tanks or reservoirs occur, many of them from three to thirty miles in circumference, and being indispensable for irrigation, may be supposed to be nearly universal in all populous districts not watered by rivers. These reservoirs are considered by the Hon'ble Colonel Morison C. B.\* as among the greatest national monuments to be found in India

They are capable, according to Buchanan,† of supplying water for from eighteen months to two years, and thus of maintaining the surrounding crops should no rain fall within that period.

They are drained by an ingenious system of sluices and aqueducts of the most simple, but complete construction, which afford a perfect control over the distribution of the water. During the dry season they are all pretty much exhausted, and may, if necessary for repairs, be left perfectly dry. This would afford an excellent opportunity for destroying crocodiles and all the various destructive fishes, sparing only the more profitable kinds, which are limited to two or three species only ; and by repeating this operation for several seasons, or as often as may be necessary, all but those we wish to propagate would soon be exterminated.

By a wise law of nature, the carnivorous animals of every class are less prolific than the harmless, and may therefore be the more easily subdued. Nearly all the destructive fishes are viviparous, bringing forth comparatively few young ; whereas, the more profitable kinds, or those which should be the object of our care, are all oviparous, and bring forth their young from spawn.

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\* To whom I am indebted for many particulars regarding them.

† See his Journey in Mysore.



A single female Carp weighing only nine pounds has been found by Bloch to contain no less than six hundred thousand ova ; and by Schneider, one, ten pounds weight, was found to contain seven hundred thousand ova, or eggs.

The fecundity of the *Ruee*, *Catla*, and *Mrigala*, has not yet been ascertained, but from their close affinity to the Carp we may suppose them to correspond in this respect with that species ; the question, however, is one that may be easily ascertained by weighing a grain of the roe and ascertaining the number of globules it contains, while these will be to the whole roe what one grain is to its entire weight. The result will show that these species are capable of yielding, by their extraordinary fertility, a source of food as inexhaustible as the sands of the ocean, could we only bring their propagation and the safety of the young sufficiently within our control.

In the reservoirs above described, we have every facility for effecting this object on a scale of great magnitude, without in any way interfering with the other uses of the water.

There are certain kinds which though they cannot be said to be carnivorous, would yet be still more fatal to our object by devouring the spawn or ova ; such are the Barbels, so common in the higher parts of our rivers, and which but for a knowledge of this trait in their character would, from their appearance and flavour, be the first we should recommend for propagation, and thus from an ignorance of one simple fact, destroy every chance of success. We should not, however, condemn all the Barbels merely from a fault in some of the species, the circumstance should impress on our minds the necessity of confining the varieties of fish in a single reservoir to the lowest possible number of herbivorous kinds, such as the three I have mentioned, namely, *Cyprinus rohita*, Buch. *Cyprinus catla*, id. and *Cyprinus mrigala*, id. ; there is reason to believe that either of these species would answer equally well in any part of the plains of India. As they usually attain a large size, they may be slow in coming to perfection, and, therefore, instead of having these three large spe-

cies in the same water, it would probably answer the purpose better to have one of them only as a principal species, with any one of the common Gudgeons or Bangons of India as a cheaper article, which would not require more than a year or two at the utmost to arrive at perfection. Beyond a single species of *Gobio*, and a single one of the larger species already mentioned, more ought not to be introduced to the same water, or allowed to exist in it, from the danger of their proving inimical to each other, a point which I presume has never been attended to sufficiently in attempts hitherto made to propagate fishes ; hence, perhaps, the want of that degree of success which no doubt would have rendered a practice so simple and beneficial, long since universal.

The only alteration in the present form of the reservoirs to adapt them to the purposes in view, would be to enclose the lowest portions of the bottom of each with stakes, long enough to reach above the highest surface of the water, and close enough together to prevent the entrance of crocodiles, otters, and the liké, should any such exist in the neighborhood. The spawning season of the *Ruee* and other Cirrhins, appears to be in the dry weather ; the contrivance here suggested would therefore protect them at that time, and if there should be any danger of the whole of the water drying up, wells of sufficient size and depth might be formed within the enclosure, to which the fishes would retire during droughts, while the shallow waters around the wells would afford space enough for the deposit of spawn.

Much of our success would depend on keeping these enclosures as free as possible from all but the species we desire to propagate. At the commencement of the dry season, before the fish begin to enter the enclosure, the interval between the stakes might be closed with straw, and as the water becomes sufficiently low without, most of the rapacious kinds may be removed or destroyed ; none should be allowed to remain, but that species alone which may be the object of our care. This done, the only further attention necessary, would be to save the fish in the enclosure from birds during the remainder of the dry season.

Should our success be complete, from every moderately sized female *Rucee* we should have on the commencement of the rains from five to ten hundred thousand fry, which, as the waters rise would be quite able to take care of themselves till the next season, when it would be necessary again to destroy the rapacious kinds, as before.

The repair of the *carays*\* of Mysore is said, by Buchanan, to be attended with considerable expense, nevertheless it is understood to be an indispensable object to have them in perfect repair, since the fertility of the country depends entirely on them. The plan here proposed of converting them to new purposes of utility would add to their importance, and the interest of keeping them up, without in any way increasing their expense.

On the fishes of Bengal, Assam, and other provinces subject to the inundations of the larger rivers, we can exercise no control, nor is it desirable that we should, even if it were in our power, the supply of fish being plentiful and constant enough ; but in the higher parts of the plains, near the foot of the mountains where the larger Cirrhins and Barbels retire during the dry season for the purpose of spawning, fisheries might be carried on with advantage to a considerable extent. See p. 339.

It would here be out of place to enter on the subject of sea fisheries, and before we could do so with advantage it would be necessary to pay as much attention, or more, to the fishes of our coasts as we have devoted to those of our rivers.

Already we have attained one important piece of information regarding the value of the *Sulea* fish of our estuaries, *Polynemus sele*, Buch., which from the earliest times has been celebrated throughout China for its isinglass. This substance was formerly supposed to be afforded only by certain fishes in the rivers of Muscovy, from whence it was exported to all parts of Europe, where, from its high price, its use is chiefly confined to the arts.

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\* Such is the name by which the reservoirs are known in Southern India when kept up for irrigation.

A solution of this substance mixed with Canadian balsam and spread on black silk forms the useful article called court plaster. A few grains of isinglass boiled in milk forms a most nutritious food, which is given medicinally.

Ignorant of its abundance in certain fishes of the Hoogly, that used by the English residents in India is still imported, probably at an expense of about 800 Rs. per maund,\* while the same thing is collected in abundance and shipped to China from the Calcutta river.†

Ten grains of this substance is sufficient to give the consistency of jelly to a pint of water, and as it keeps good in a dry state for any length of time, we may imagine its value as a portable food, and what its importance might be in times of scarcity, since one pound avourdupois, at the above rate, would afford a nutritious meal to 1560 persons.

Whether it be used in times of scarcity in China I do not know, but probably it is collected and stored to meet such occasions, since Dr. Lumqua—an honorary member of this Society—a Chinese Physician, long resident in this city informs me that the Bengal *fish-sago* procured from *Poly-nemus sele*, Buch. is known throughout the empire, and that nothing could surpass his surprise on his arrival nearly twenty-five years ago in Calcutta, when he found that with the exception of his own countrymen who carried on the trade, no one appeared to know or care anything whatever for the article in question, and as no one could describe the fish, the same ignorance continued up to within the last few months to prevail on the subject. The advantage, however inconceivable of an abundant supply of any substance, a single maund of which would afford a nutritious meal to upwards of one hundred thousand persons, could only be felt occasionally, but the intrinsic value of the article in all the common conveniencies of

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\* It is retailed in Calcutta at a much higher rate.

† See Journal of the Asiatic Society for March 1839.

life, is eminently calculated to direct attention to other uses of the species affording it.

This is one of the largest and finest fishes, both as regards flavour and wholesomeness, on our coasts or in our rivers, while the season at which it is taken is the one most favourable for a residence in boats or ships in the Sunderbuns. Under these circumstances it is not likely that the subject of sea fisheries in this quarter will be altogether overlooked, longer than the circumstances on which their success must depend shall have been properly examined.

All sea fisheries are practised on migratory species, which advance annually at stated periods in search of food and proper situations to deposit their spawn. Their progress is so regulated, that at certain seasons they approach the different coasts, in their course, with so much regularity as to enable the people to repose as much confidence and hope in their coming and departure as they usually place in the ripening of their crops. The shoals of fishes are so dense as to cover the sea for leagues without interruption, and extend to a solid depth of many fathoms in some instances, so that they are taken as quickly as it is possible to salt and barrel them. The season lasts from a month to six weeks, when thousands of ships are laden with cargoes which are to serve as the common stock of food for many of the surrounding nations for twelve months, when the fishing is recommenced.

Such are the fisheries on the banks of Newfoundland, on the coasts of Norway, Sweden, and Great Britain; and unless the coasts of India afford promise of resources of similar extent and importance, the object would hardly require much public attention. If, however, it be found that we have species on our coasts equal in every respect to that which is the object of enterprise at Newfoundland, and that these advance into the Sunderbuns at a season when ships and men without number may be employed with safety, there can be nothing to prevent the national importance of the circumstance.

In this instance, as well as in that of the propagation of fresh-water spe-

cies, science, while it exhibits varieties as numerous almost as the stars, teaches us at the same time how to strip the subject of vagueness arising from this cause, and amidst the countless species which inhabit our seas, directs our attention and our energies to a few only, and of these the *Sulea*, or *Polynemus sele*, Buch. is the one which from its bulk, its habits, and its qualities in every way seems capable of becoming a permanent benefit to society. It appears to be the Cod-fish of the tropics, and equals its representative in the northern seas in all those qualities which render that species so invaluable; but from its bulk it is unmanageable by the Indian fishermen, who are also without the means of preserving it.\* These however are not sufficient reasons why an article that might add an exhaustless supply to the common stock of food should be altogether lost, now that an European spirit, under the influence of a paternal government, begins to infuse itself in all things connected with the resources of India.

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\* It must have been long known that the difficulty of preserving meat depends more on the state of the atmosphere in regard to electricity and moisture than on temperature. In Calcutta, in the month of December, when the mean temperature is about 60°, it is not uncommon to keep meat before it is dressed for eight days, though in England during the summer at the time of the herring fishing too, it cannot be kept in the best meat-safes for more than half that time, though the temperature be lower than here. With salt and other means at hand, I conceive there would be no difficulty in curing fish in an Indian climate in the months of November and December, when the *Sulea* fishing would be carried on; nevertheless the subject is one of much interest, and I cannot therefore omit the following remark with which I have been favoured on this head by Mr. C. K. Robison, one of the Magistrates of Calcutta. "It would be a famous thing if these enormous fish (the *Sulea*) could be cured, as well as their isinglass obtained; and I cannot help thinking the measure very feasible, if the fishermen at the time of taking them and cutting them up, dipped them first into weak chloride of soda mixed with a small quantity of impure pyroligneous acid. This would not only preserve the fish till the salt acted, but improve the flavour." These materials could be manufactured at a very cheap rate on the spot, as well as every thing else that would be requisite. For an account of the *Sulea* fish, see *Journal Asiatic Society Bengal*, March 1839, p. 203. Also an article on "some Indian Fishes by Dr. Cantor," *Proceedings Royal Asiatic Society*, April 1838.

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*Desiderata.*

Collections of fishes from Mysore, as well as other parts of India in which similar isolated waters occur, with remarks on the habits of the more important kinds, as well as on the fitness of the waters for the mode of propagation here proposed, or for any other mode that might promise more success, according to particular circumstances.

What are the migratory fishes of the coasts of India, the seasons and places at which they appear, particularly the grand resorts of the shoals?

What are the habits of the *Sulea*, (*Polynemus sele*, Buch.) and its chief places of resort?





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